

Aviation Week

and Space Technology

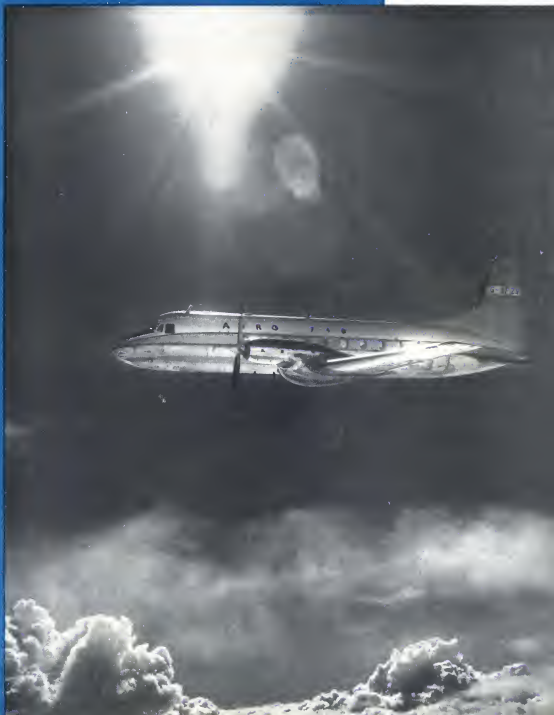
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A McGraw-Hill Publication

September 19, 1960

Special Report
On IATA
General Meeting

Avro 748 Turboprop



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INFORMATION STORAGE AND PROGRESS OF MAN

If the technological history of man's accomplishments were divided into a twenty-four hour day, the accomplishments of the twenty-fourth hour would easily outweigh the sum total of the first twenty-three. The surge of progress has resulted in part from man's ability to permanently record and use information relative to his experience.

The writing of human experience — the first permanent information storage system — began only 10,000 years ago. The pages of history written since, would require a storage area larger than the Empire State Building to contain them. Thus man's ability to chronicle facts has far exceeded his capability to store them for easy reference.

Now specialists in the Planning Division and ASTRD, Marquardt's division for research into the space age, are developing a multi-channel information storage system with an order of magnitude superior to any known storage method. RESULT: all information recorded during the first 100 centuries of civilization's history may be stored on a 6 foot cube.

The future, viewed in the perspective of this new memory potential, offers man the opportunity for an even greater rate of progress — whereas it is possible to envision the achievements of the last decade of the twenty-fourth hour exceeding the sum-total of the first 1,000 centuries.

New information storage concepts typically lack one aspect of The Marquardt Mission. Creative engineers and scientists are needed.

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AVIATION CALENDAR

- Sept. 27th—Space Power Systems Confers once, American Rocket Society, Montreal Hotel, Santa Monica, Calif.
- Sept. 28th—Conference on Solid State Nitrogen Plastic Deformation, Johnson, N. C. Sponser: Air Force Office of Scientific Research, National Science Foundation.
- Oct. 1—Second Annual Fly-In for General Aviation, National Aviation Facilities Experimental Center, Moline, Ill. N. I. Sponser: Federal Aviation Agency, Bureau of Research and Development.
- Oct. 2-4th—Federation Aeronautique Internationale Annual Meeting, Barcelona, Spain.
- Oct. 3-4th—Nuclear Communications Symposium, IRE, Union, N. Y.
- Oct. 4-6th—Second Annual Meeting, Institute of Radio Engineers, Professional Group on Nuclear Science, Galveston, Texas. Cosponsor: Oak Ridge National Laboratory.
- Oct. 15—National Microwave Conference on Air Motion, Institute of the Aeronautical Sciences, Tulsa, Okla.
- Oct. 25-27th—First International Air Traffic Control Conference and Fifth Annual Meeting of the Air Traffic Control Association, Sheraton-Fairfax Hotel, San Francisco.
- Oct. 4-11th, Annual New York State Aviation Development and Operations Conference, United Development Services, N. Y.
- Oct. 4th—Radio Conference on Radio Interference Reduction, Chicago 12 Sponser: American Research Foundation, U. S. Army, U. S. Navy, USAF, IRE.
- Oct. 5th—Reading Seminar on Opponents in Space Age, Technology, American Management Assn., Sheraton Hotel, New York, N. Y.
- Oct. 5th—Annual Convention, Aeronautical Engineers, El Comodoro Hotel, San Diego, Calif. (Continued on page 6)

AVIATION WEEK and Space Technology

September 16, 1960

Vol. 75, No. 12

AVIATION WEEK and Space Technology is a publication devoted to the advancement of the aerospace industry. It is a weekly publication that covers the latest news and developments in the field of aviation and space technology. The publication is published by the Aviation Week Group, Inc., and is distributed to a wide range of subscribers. The publication is a valuable resource for anyone interested in the aerospace industry.

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missile / AEROSPACE COMPONENTS BY LAVELLE

Sheet metal wall thickness is controlled as the outer surface of an aluminum alloy nose cone is machined to precision size on a boring mill at Lavelle. Part of the RVX Series re-entry vehicle structure, recovered after full KCBM range flight, the machined cone is typical of methods used by Lavelle to meet the varied requirements of the aerospace industry.

Shown below the nose cone structure above is a part of the Hawk missile system, a radar pedestal base magnesium welded-in-perturb machined after assembly. Lavelle works with a wide range of metals and alloys to produce such metal components for missiles, electronic systems and ground support equipment to existing specifications. Major contracts rely in Lavelle for precision components required in missiles, space vehicles, jet engines and windtunnels.

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(Continued from page 3)

Oct. 6-8—Society of Experimental Test Engineers Symposium on "Crash Tests Flight," Los Angeles Hotel, Los Angeles, California

Oct. 7-9—Fourth Annual Meeting of the American Society of Mechanical Engineers, San Francisco, California

Oct. 8-9—National Conference on High-Speed Photography, Santa Monica Hotel, Santa Monica, California

Oct. 8-9—Third Annual National Aero Club Football Day, Michigan at Detroit, Ann Arbor, Michigan

Oct. 10-12—1958 National Electronics Conference and Exhibition, Hotel Sheraton-Columbian, Washington, D.C.

Oct. 10-14—Society of Automotive Engineers National Automatic Meeting, Ambassador Hotel New York, New York

Oct. 10-14—Annual Meeting of the Society of Automotive Engineers, Los Angeles Sheraton Hotel, Los Angeles, California

Oct. 10-14—Research National Symposium, American Vacuum Society, Specialized Conference, University of Illinois, Urbana, Illinois

Oct. 14-15—Symposium on High-Speed Photography, Society of Photographic Scientists & Engineers, Washington, D.C.

Oct. 14-15—Annual Meeting of the American Society for Quality Control, Renaissance Hotel, Waikiki, Honolulu, Hawaii

Oct. 14-15—2nd Asia Conference on Aircraft Operation Center San Francisco, Calif.

Oct. 15-16—Joint Meeting, Institute of the Aeronautical Sciences and Canadian Aerospace Institute, Queen Elizabeth Hotel, Vancouver, Canada

Oct. 17-21—International Safety Councils 4th World Safety Symposium, Concordia Hotel, Chicago, Illinois

Oct. 19-21—Annual General Assembly, Southern Railway System, Jacksonville, Florida

Oct. 19-21—Symposium on Space Systems, University of North Carolina, Chapel Hill, North Carolina

Oct. 19-21—Annual Meeting, Society for Experimental Stress Analysis, Hotel Chalmers, Stockholm, Sweden

Oct. 20-22—National Symposium on the Velocity Techniques Institute of the Aeronautical Sciences, Theta Tower Hotel, Houston, Texas

Oct. 24—Bibliographical and Biological Aspects of the Kingdom of Spain, Unpublished Booklet, Madrid, Spain

Oct. 24-25—Second Annual Conference on Transients, Sponsored by the School of Aviation Medicine, Arranged in South America, Buenos Aires, Argentina

Oct. 24-25—Radioactive and Great Conference on Astronautics and Nonspatial Elements, Institute of Radio Engineers, New York City, New York

Oct. 28-27—15th National Conference on Standards-Measurement, Hotel NY C

Oct. 28-29—1958 Second Electronic Devices Manufacturers Association Radio Engineers, Hotel Sheraton-Washington, D.C.

Oct. 29-28—1958 Industry Display Atomic Energy Society, Pacific Auditorium, Los Angeles, California

Nov. 2-4—Smith Army Airfield Conference, Fort Pitt Warfield Hotel, Detroit, Michigan

Nov. 2-4—United States Conference on Space Road Course (Invitational)

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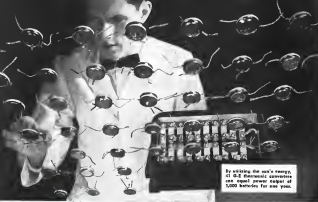
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MISSILE AND SPACE
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...center for missile and space technology research
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Progress in power for space

Manned space flights, as well as other U.S. space projects, will require new, lightweight, long-life sources of electrical energy. Conventional batteries, now being used in satellites and satellites, are far too heavy for most future space applications.

For example, during a year's operation, one thousand 15 ampere batteries, similar to the one shown above, would be required to equal the 41 watts which the thermionic converter in the photo can generate from the heat of the sun. These batteries would weigh 15,000 lbs.—a complete thermionic system, including the converter developed in General Electric's Research Laboratory plus a collector and orientation equipment, only about 50 lbs.

To provide such new, light-weight systems, engineers at General Electric's Missile and Space Vehicle Department are investigating a wide variety of promising space power sources, utilizing the specialized capabilities of other Company research operations. For instance, under U.S. Air Force contract, G.E. is conducting extensive research in thermionic, and is developing an experimental thermionic system consisting of a solar collector, converter, and storage

and control components. Intensive work in photo-voltaics includes the development of an advanced unit to provide more than 500 watts of continuous power for the Advent communications satellite.

For the U.S. Army Signal Research and Development Laboratory, a representative fuel cell is under development, as are magnetohydrodynamic electrical converters for the Air Force Office of Scientific Research, WADD and RMD. In addition, MSVD is investigating nuclear thermionic and nuclear turbines.

To learn more about these MSVD space power developments, write to Section 980-78, General Electric Co., Missile and Space Vehicle Department, Philadelphia 1, Penna.

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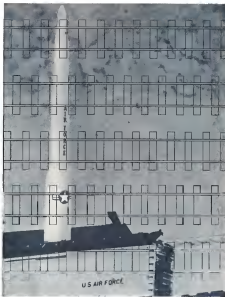
A highly mobile, electronic air defense system ensuring nearly instant destruction of hostile aircraft by coordinating state-of-the-art missile firing at split-second speeds has modernized the field army's air defense capabilities. This "vest pocket" air defense, designed in standard, heavy-duty 500-ton Army trucks, is another high-quality development of one of America's leading manufacturers of military electronic systems, the Hughes Aircraft Company.

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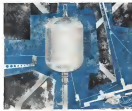


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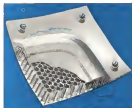
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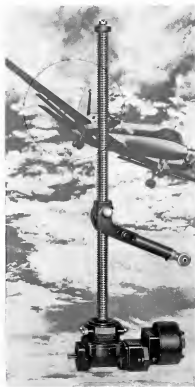
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'The Air Bites Shrewdly'

The question from Harriet (Act 1, Scene 4), used by Danish poet Poul Hennrich in his prologue, "Hem to the Air," composed specially for the opening session of the nineteenth annual general meeting of the International Air Transport Association at Copenhagen, certainly applies to these proceedings that transpired in the Danish capital last week. IATA has never met in a place more apt than Copenhagen but it has never seen in many acts of internal disintegration more to be seen in the meeting that just finished. At the same time, United States and Scandinavian delegation began negotiations on a new bilateral that promises to be typical of some better international ones ahead over traffic rights.

Both acting President Seigo Yonaga of Japan Air Lines and Alec Rank, head of Scandinavian Airlines System who scarcely has in the IATA club, made pointed references to the absolute necessity for freedom of the air in their opening addresses, although the Yonaga reference was several more at the Soviet Union whose scaling off of the vast Arctic airspace prevents real efficiency of polar routes. But no doubt remarks of Rank and Danish Prime Minister Viggo Kampmann were aimed at traffic rights negotiations that for the U.S. extends to oppose its current bilateral negotiations. Whatever the outcome of the issues of bilateral now being negotiated, it is certain that the rigid structure of IATA is making like the rigidity of a sailing ship in heavy weather under new pressure from member airlines who now discover that they have very little voice in major IATA affairs.

Unless this rigid structure is modified and some of the traditional sails are reefed, current controls of IATA are likely to find themselves steering a disabled ship, uncontrollable in the heavy weather of shrewd competition. Specific points of dissatisfaction with the IATA regime are varied, but they all focus on the fact that many delegates to the annual general meeting are rushing for the first time that there are no opportunities for discussion on, or amendments to, IATA policies that are determined solely by the executive committee and the director general. Its discovery leads to a further analysis of executive committee composition which indicates it is dominated by a few of the world's largest airlines through their own memberships and appointments from their subsidiaries.

It also is apparent that with the current composition of the executive committee the director general wields considerable more authority than is consistent with the democratic procedures that IATA so loudly embraces in public.

Whatever the director general's past contributions to IATA this have been, and we regard them as substantial, it is apparent that his British colonial administrator's approach to members in producing about the same effect in IATA that his administration of the Stamp Act produced in American colonies nearly 200 years ago.

The current rebellion is still in its early phases and can be easily dissipated by the incumbent IATA administration because few signs can be seen outside

the secret sessions of the annual general meeting and other technical and traffic conferences. But those who now seeds of this movement sown in Tokyo note considerable growth of this feeling in a year's time and several specific incidents including the director general's peremptory order of the IATA traffic director, John Brackner, a man of unique ability in a difficult turf area, have defined the new democratic processes of IATA more sharply. Although past annual general meetings have been largely social affairs for delegates and their wives, with working sessions merely rubber stamping decisions already made by the executive committee and the director general, an increasing number of them feel it no longer is worthwhile to travel so far for this purpose and that there must be some place in the procedural framework of IATA for fuller expression of views and debate before decisions are made.

As an example, none of the reports made at the meeting are distributed to delegates in advance of their presentation. Since these are long and complex reports, it is impossible for delegates to either understand them without detailed personal or to comment on them intelligently during the meeting. Similarly, nominations for selection of executive committee members were chosen when offered from the floor with the suggestion that they be submitted later by letter. Another time, just during which several reactions in Copenhagen to having airline manufacturers from the IATA meeting area. The bus has not been 100% successful, with at least two non-American manufacturers in evidence, but many airline people, particularly those smaller operators, feel the bus has left a load in useful benefits that others from the annual general meeting because they are unable to arrange technical talks in ample free time between rubber stamp business meetings and the evening social program.

Again huge airlines that now dominate IATA policies have an ample opportunity for this type of technical discussion during the year but smaller operators do not. No doubt some manufacturers exhibited poor taste in behavior at IATA sessions, particularly in denouncing others for themselves and their when at IATA social functions, thereby putting a heavy burden on the host country and airline, and in failing to synchronize their activities with bills in the IATA program. However, complete rule imposed by the executive committee of IATA does not really solve this problem and it should be worthwhile for both IATA and the airlines and manufacturers to work out practical ground rules for activities during annual general meetings.

As the director general of IATA noted in his opening remarks, turbulence is a hallmark of the contemporary world. His exhortation to delegates to stay in the IATA boat and stop rocking it toward a danger of capsizing probably would have earned more impact among delegates if they had been accompanied by more signs of democratic procedures in managing business in this organization.

—Robert Hots

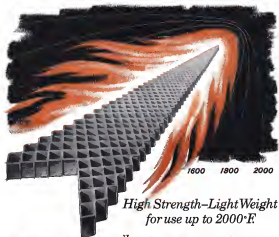
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Baltimore, Indiana



High quality and availability of HAYNES wrought alloys are assured because they are produced in an area plant by experts. Sheet, above, is being heat-treated on a 20-ton mill.

The words "Haynes", "Haynes", "Haynes" and "Haynes Carbide" are registered trademarks of Union Carbide Corporation.

Washington Roundup

Arms Control Agency

More than a year of study and debate has ended in the creation of the U. S. Disarmament Administration within the State Department. Soviet Russia's expert use of the nuclear testing and arms control issues in propaganda devices has often caught the U. S. off base, causing considerable criticism within and outside of government.

Lack of a clear-cut U. S. position has been due partly to the conflicting needs and interests of State, Defense Department and the Atomic Energy Commission. Groups that studied the problem generally agreed that a control body to advise on policy was needed, but State, Defense and the White House staff have engaged in a three-week jockeying match over where it should be located within the government.

Sen. John Kennedy, Democratic presidential candidate, was, however, inadvertently declared beneficiary of the arms control group last spring when he proposed such a body in a major speech—according the Administration on a suggestion made in a still secret report by the Coolidge Committee Disarmament Study Panel. Although others including Sen. Robert Taft, had made similar suggestions before, the fact that Kennedy was first to insist that the Administration could not immediately take an action that a Democratic candidate had not recommended.

Not the least of the national questions even now was whether the words "arms control" were preferable to "disarmament." State picked the latter. The new agency's mission is to "marshal in a single unit political, military, scientific and technical skills" in an attempt to "disarm" nuclear threats by using the burden of disarmament, leaving the dangers of war in control, and helping to promote a just and durable peace.

Khrushchev's Security

Exchange of experiences that has eased U. S.-USSR relations since last May when the U-2 went down inside Russia continued. State Department's restriction of Soviet Premier Khrushchev to Manhattan Island during his visit to the United Nations was attributed primarily to concern for his security. State said during this security for the premier and his delegation has been complicated by the hostile public statements he has made and "by the destruction of an American (RB-47) plane over international waters by Soviet action and the continued illegal detention of two American spies."

Attempts to disseminate the operational readiness and accuracy of the fast U. S. ICBM, the USAF Convair Atlas, have been disappointing. Three recent tests to fire Atlas from Vandenberg AFB, Calif., into Ecuador, AFB have failed. The first was aborted on the pad, the second range was obstructed shortly after launch and the third that last week—on a third three minutes were covered down just for insurance—ended in a successful detonation. On at least two of the last, SAC Commander Gen. Thomas Power was riding near the shell in his KC-135 command aircraft. More shots are planned.

Defending Mercury

Unhappy with continuing criticism of Project Mercury, NASA officials are taking the offensive. George M. Low, chief of manned space flight, said to position of U. S. can most certainly keep the U. S. in second place in space. The program was begun with a clear understanding that Russia probably would be first to entered orbital flight—and if Russia could achieve orbitation the U. S. might be able to take some steps. Since this is unlikely, Mercury is a necessary step toward Apollo, the proposed multi-man satellite. Voposna, unmanned version of Apollo could get the U. S. leadership in space, Low said.

Defense of Mercury extends even to the program's public relations aspects. Life magazine has a controversial contract with the men astronauts for exclusive rights to their personal stories. No criticism about the men have been the subject of press conferences two days later, an interview session, 35,000 words in transcripts and releases, 600 still photos, 6,000 ft. of movie, five photos using cameras and 16 verbs to Space Task Group for accuracy. Public Information Director Walter T. Rauscher told a group of editors.

W ragup

As Force and Defense Department are trying to arrive at a mutually acceptable B-70 program. ARDC has submitted a report of possible conclusions. ARDC Commander Lt. Gen. Bernard A. Schriever insists that as basic change in requirements will result from current ARDC-AMC talks and redesign of various problems, possibly involving the operational commands. After... Dr. Herbert York, recovering from a heart attack, plans to return to his job as director of research and engineering in Defense Department probably in mid-November and possibly, as a part-time basis of first.

—Washington Staff



McDonnell Phantom II jet fighter for U.S. Navy carries six Sparrow III missiles along under wings and belly; this is first photo of the airplane with Sparrows attached to new under wing missile racks. Missiles carried on the belly section are not mounted.

McDonnell Phantom II jet fighter for U.S. Navy carries six Sparrow III missiles along under wings and belly; this is first photo of the airplane with Sparrows attached to new under wing missile racks. Missiles carried on the belly section are not mounted.

Large Solid Space Boosters Studied

By Edward H. Kelman

Washington—Studies of solid propellant rocket motors capable of mounting 1 million lb and 7 million lb space vehicles are being initiated by National Aeronautics and Space Administration to determine whether solids can compete with liquid propellant for major space applications.

These vehicles—in the Saturn and projected Navy aircraft launch class—would be the first "super boosters" combining solid first stages with liquid upper stages. Upper stages would be the highly promising liquid hydrogen vehicles now under development by NASA.

Three companies—Avco-General Corp., General Electric Rocket Co., and Thiokol Chemical Corp.—have been selected from among seven firms submitting proposals for solid staging, in conjunction of large solid boosters. They will share approximately \$225,000 for research, in month NASA studies on two specific vehicles.

Thrust-Weight Ratio

Both vehicle concepts envision use of two or three hydrogen-oxygen upper stages. Saturn would have gross take-off weights of 4 million and seven million pounds, with about half the (take-off weight) concentrated in the solid first stage, going there about as much faster (thrust-to-weight ratio) in the first stage than the large liquid rockets will have.

Thrust-to-weight comparisons would be used for orbit orbital missions, and for stage vehicles for planetary flights. Robert A. Wiest, manager of NASA's advanced solid propellant technology program, said that although no experience exists in giant solid boosters, potential advantages of solids over liquids for large applications were well noted in specific studies conducted for NASA last year by Lockheed Aircraft Corp. and Avco-General Division of Ford Motor Co. Current studies will extend those of Lockheed Aircraft, which used estimated design data to determine the value of further investigations.

In addition to the obvious gains in handling and storage, these NASA studies concluded that solids are three vehicles more efficient because they can readily develop desired higher thrust-to-weight ratios and suffer less gravitational loss than the longer burning liquid boosters.

With less characteristic, a solid booster stage could be built perhaps 80% smaller than a liquid with the same mission, and more weight could be added to the effective hydrogen oxygen upper stages and payload.

First stage for a 3 million lb gross (take-off weight) vehicle using a solid booster would weigh about 500,000 lb. In comparison, the all-liquid Saturn C-4 configuration, with a gross take-off weight of about 1.16 million lb, will have about 80% of the total vehicle weight in its first stage.

Wiest said big solid boosters must

compete with Saturn-type engines because Saturn is well into development and comparable solids are theoretical, but he feels that additional studies will show solids in a position to compete with liquid propellants in cost and performance.

Areas of Exploration

Below major funding or research efforts can be pushed in big solid boosters, NASA feels it must go beyond the broad parameters of the Lockheed-Avco studies into those areas which liquid propellants in cost and performance.

• A general feasibility definition of the large solid first-stage concept using current technical knowledge.

• Optimum vehicle configuration, including recommendations for arrangement, clustering, nozzle arrangement or constructing a single massive joint of propellant. Segmented solids should offer the advantage of the flexible, moldable liquids (see AW June 15, p. 25).

• Definition of a liquid development program for large solid rockets.

• Detailed cost analysis for an overall program, including personnel, material and equipment cost of development.

• Methods of steering, error free, vision, retention, recovery or other techniques.

• Methods and parameters for destruction.

• Procedures for quality control.

NASA hopes to obtain detailed answers to these problems from three different viewpoints: in the Army, General Grant and Throckmorton studies.

Several concurrent projects sponsored by NASA and the Defense Department are expected to complement the two very large booster feasibility study. NASA already completed negotiations with Rocketdyne for \$44 million development program for 12 hydrogen-oxygen Saturn upper stage which could be the upper stage for the large solid. Air Force has a \$6 million contract with Aerojet aimed essentially at determining the feasibility of reusable large segmented solid rockets and NASA has a \$240,000 contract with United Technology Corp. to build and test five three 1,000-lb solid motors, each made in three segments.

NASA also expects to take advantage of missile technology and other new developments in Minuteman, Polaris, Poseidon and Zeus programs.

Rocketdyne and its work that negotiations with NASA had been completed for House development and qualification program for the J-2. Earlier estimates gave development time in three years (AW June 6, p. 31).

Air Force estimates that large, segmented boosters could be put up to four times the weight of Minuteman, which is the largest solid motor now under development for a specific mission. General Grant is providing supporting research in the segmented studies.

NASA expects to make for the United Technology segmented rockets used with the solid NAVA and Air Force are making all segmented concepts in their booster through development and assembly. Both are also intended in possible means for petroleum development points of propellant so that more rocket would not have to be developed.

Boeing Engineers Reject Proposal

Boeing Aircraft Co. engineers at Wichita, Kan., and Seattle, Wash. have rejected the company's offer in the 1960 collective bargaining negotiations. The Seattle Professional Engineering Employees Assn. complained that Boeing's offer contained "solid" "solid" in making benefits.

Group represents 5,000 Boeing engineers.

The company offer eliminates a clause providing two weeks' notice prior to leave and imposes an obligation on the criteria to be used in selecting which engineers would be laid off. The company has offered a 1% general increase, abandoning terms of the past four years under which the salaries of experienced engineers were adjusted by the amount which beginning salaries increased in the preceding year.

Kennedy Names Defense Reviewers

Washington—Democratic presidential candidate Sen. John F. Kennedy (D-Mass.) last week named five prominent attorneys with previous government experience to a special committee under Sen. Stuart Symington (D-Mo.) to review the organization and management of the nation's defense structure. They are:

• Thomas K. Finletter—Secretary of the Air Force from 1948 to 1953 and chairman of the President's Air Policy Commission from 1947 to 1949.

• Clark M. Clifford—Special counsel to the President from 1946 to 1953 and helped draft the National Security Act of 1947, and was naval aide to the President in 1946.

• Roswell L. Gilpin—Under Secretary of the Air Force from 1951 to 1955 and a member of the Rockefeller Special Studies Project from 1956 to 1957. He also was a member of the Advisory Panel to the Joint Congressional Subcommittee on Military Appropriations of Atomic Energy.

• Fowler Hamilton—Chief legal counsel of Department of Justice in 1945, general counsel of the Senate Subcommittee on American in 1956 and chief of the House, Branch of the Foreign Relations Administration from 1942 to 1943.

• Max Lora—Special assistant to the Secretary of the Navy in 1947 and special assistant and counsel to the Secretary of Defense from 1947 to 1955.

Dr. Edward C. Wells, legislative assistant to Sen. Symington since 1955 and deputy administrator of the Office

of Four Administration from 1948 to 1949, will serve as executive director.

The committee's work will be to conduct an administrative and management of the Defense Department and related agencies and organizations. Kennedy said it will deal with such matters as the relationship between civilian and military, defense making in the Defense Department, the role of the Joint Chiefs of Staff and the big role in new weapons.

"The crucial question," Kennedy said, "are those of judgment as to what the President should be able to do in the defense and administration of our defense agencies to eliminate or at least to diminish the present crippling effect of these problems upon our defense power."

He said the committee will seek the views of each military service and of defense industries as well as qualified and experienced civilians, regardless of their political affiliation in particular service backgrounds.

"We must improve the administration of our defense agencies and we must do it without delay," Kennedy said. "It is not the committee will make recommendations to us as to the manner which legislature or courts may then should be taken to achieve two primary and related objectives: to achieve a defense adequate to protect the nation and enable it to discharge its international responsibilities, and to obtain such a defense under the finest work of a free and vibrant economic system."



Navy Accepts First Piper Aztec Twins

First of 20 Piper Aztec twins ordered by U.S. Navy and designated DO-1 have been delivered to Annapolis NASC, Washington, D.C. First design in red, white and black, DO-1 general support and spare will be handled through Piper service organization.

Techniques of 'Project Needles' Detailed

By Philip J. Klein

Lexington, Mass.—First details of "orbital fusion communications," a promising new technique that will use earth-orbiting belts of millions of tiny laser-like satellite transmitters, were disclosed here by Lincoln Laboratory, which has been managing the technique with Thompson Radio Woodstock under Defense Department sponsorship.

Somewhat well attempt to place such a belt of scientific shakiness into orbit in the next few months as a "paddy boat" experiment aboard another satellite (AW Aug 1, p. 78; Aug 12, p. 105).

Siegfried Bacht

The belt will consist of spheres of two metal whiskers, or dipoles, less than 0.001 in. in diameter and about 0.8 in. long. The dipoles, weighing about 220 lb. per billion, will be ejected from a satellite as it circles the earth. The result will be a continuous belt of signal-receiving surfaces which appear to remain fixed in space. An orbital belt in an equatorial orbit, at any altitude, would receive fixed radio signals to earth stations except for small orbit perturbations.

Lincoln Laboratory studies indicate that if the two dipoles are spaced about a wavelength apart with a distribution of velocities of up to a maximum of plus or minus 10 fps, the belt fed down will close upon itself in roughly one month and will assume a reasonable degree of alignment in two months.

If depoles are cycled in all directions, the belt can be expected to spread about 20 cm in a direction radial to earth (thickness) and about 5 cm in



MILLIONS of fly-ash dusts, less than 0.002 in. in diameter, will be ejected into orbital belt by dispenser satellite. A ball of fine-ash dusts weighing 270 lb., can cover variable belt.



ORBITAL SCATTER communications, using two or more belts of millions of tiny metal whiskers in orbit around earth, could provide continuous navigational coverage. Technique was developed by Lincoln Laboratory and Thompson Radio Wavelength Corp.

width, with the bulk of the dipole concentrated in a narrow portion of the belt. Average separation between individual dipoles is a 1,000 m or so; would be about 1,000 ft.

Once the orbital belt of dipoles is created, it can be used in much the same way as a passive communications satellite, with ground stations reflecting signals off the belt.

Technique's Advantages

In a report delivered in London at a recent meeting of the International Scientific Radio Union, Lincoln Laboratory's W. E. Massey, Jr., cited these advantages of the new technique, compared with conventional passive ion-exchange methods:

* Two dispenser satellites could produce two orbital belts, one in an equatorial orbit and the other in a polar orbit, which could provide worldwide global coverage. Belts should have a lifetime of several years before disposal becomes dependent enough to require replacement.

• **Cervical rotation:** increases used with an internal dipole shift (can also be a low internal dipole, need only be able to shift area by a few degrees per day)

accumulate slight perturbations in its orbit. Antennae equipped for passive communication satellites in effect like synchronous equatorial orbits must be able to track them at relatively high speed, avoiding antenna cost and complexity.

* Considerable numbers of ionospheric communications channels can be provided by a single belt of dipoles because of the large number of scattering (reflecting) locations available around the earth.

Basic Concept

The basic concept of adult status determinations is credited to Vernon and Harold Myers of Thompson-Kane Woolbridge Corp. Investigation of feasibility, conducted under the rule name Patent Nozzle, was recently classified to patent. State Department is active after release of the final coming agreement. Unannounced purpose of Myers' report was to explain the technique to international radio scientists and to assure them that despite belts would not interfere with radio streams, space communications in other space programs.

The environment of the tree depends on

oider through the home of a local ground squirrel will create some discontinuous propagation characteristics, Moxon pointed out. When antennas with beamwidths of a fraction of a degree are used so that the half-5th the beam, multipath delays of 100-1000 microseconds can be expected. Mox-

reasons is the fact that rotation of the diplexer will cause significant delay to change at a rate of 200 to 1,000 times per second. This diplexer must characteristic suggests the use of non-redundant pulse code modulation techniques for the best results. Moreon is desired.

The multipath delay is comparable to that now obtained with multiplexed scatter but the fading rate is about 100 times higher. Mariani believes that the use of digital transmission techniques, both for data and voice, will be necessary to cope with these limitations of the direct link.

Using a hot bed produced by approximately one billion diaphotons, yielding 120 W, at an altitude of several hundred thousand feet, should provide commensurate data capacity of ~ 5 five tons of lithium per second at the generators in the microwave band. Maximum predicted Gamma fluxes would have intensities of 60 W, due to a transmutic ratio in output of 10 kA, as contrast compared with low power Microwaves.

Data capacities of up to one million bits (one megabit) per second could be achieved if a larger mass of diaphotons was used to produce the mobile bath. Moreover indicated.

No Interference Expected

The use of a belt of tiny dipoles has several advantages over other types of reflectors: in addition to those cited earlier. Because the dipoles resonate at only a single frequency and thus reflect, or re-radiate, at that frequency the belt is effectively transparent (non-reflective) at other frequencies. This is an important consideration for radio astronomy and for communications with man's probes.

Andrew indicates that the orbital belt will cut intensity of light from stars by only one part in 10 billion, while radio signals from stars will be reduced by less than one part in a million at the dipole resonant frequency, far less at other frequencies.

A parcel of heavy dipole whiskers in orbit can provide as much effective signal reflecting area as approximately 1,000 lb. of material in the form of a conventional hollow-sphere powder concentration orbit. Moreover, Microwe claimed. This gives the new technique a 1,000 to one weight advantage in terms of orbital.

Computational studies made on the effect of solen radiation pressure acting on the low-energy dipole indicate that orbital

penetration can be about 60 to 120 nm. If all dipoles had the same orientation to submit, the effect on the belt would not affect its usefulness. But because the dipoles all have random orientation, the salt-crystal penetration will result in changes of dipole denses within the belt.

How much random transverse depolarization within the belt will affect its latencies in non-visual study. Presently, no estimates are that the greatest part of the belt depolarization in a radial direction (thickness) will occur within the first 60 days, amounting to about 25 mV. Depolarization is estimated at 60 ms after again.

During this same time the belt color will undergo perturbations which are expected to be substantially greater than its degradation. These will be principally a cyclic variation in color occurring with a period of several weeks.

10. (11)100 when the population is constant. It is a bit to point out that at an altitude of about 2 100 m, the penguin is expected to be forced into the atmosphere after about 12 to 20 months. Larger Mammals can be obtained at higher altitudes.

Most scientists think that disintegrating Jupiter, which would scatter the debris from space after their useful life has expired, are being investigated. Most promising technique, by which it is to take the debris from a within its orbit, instead of ejecting it to space. Debris would turn to gas, so that from the cumulative effect of its temperature condensed when in the earth's shade. Solar radiation persons would cause this gas to re-enter the earth's atmosphere. Vase argued by the debris to turn to dust would be controlled by satellite allowing of the, the, Mexico, changed.



British Develop Blue Water Missile



North American Flies First Two Production Sabreliners

First two production models of North American's T-10 transport Sabreliners put up in a test field near Orlando, Calif. No. 1 Sabreliner (AW May 16, p. 138) shown in background had just completed 1,337th flight. U.S. Air Force has ordered 54 Sabreliners. Foreground are two Pratt & Whitney JT2D engines (JTB).

Rise in Turbine Aircraft Leads FAA to Update Maintenance Rules

Middle, N. J.-increasing importance of the turbine engine and resulting complexity of turbine and electronic aircraft was underscored last week by Federal Aviation Agency in a move to drastically raise its progressive maintenance rules.

Outlining the rules will result in a new package of inspection and overhaul time limitations to replace the present permit inspection limits, as outlined by Charles Schack, chief of FAA's general aviation maintenance branch who spoke here at Aeronautics Council's annual Operations Symposium.

In effect, the new rules before accepted reflect practice of maintenance professionals, Schack pointed out. The figure the rules will be completed within one year—applied strictly to the General Aviation category and Lockheed JetStar—after a wide spread investigation within the industry.

Schack and FAA first will set up a maintenance manual based to work with inspection and maintenance to set up the new time limitations. General aviation will participate through dual sessions under the provisions of the Administrative Procedures Act.

Schack's statement that FAA would overhaul its maintenance rules was

granted with intense interest by some 400 attendees, all of whom are in some way concerned with this phase of government control.

Schack stated that FAA is aware of the limitations of the present inspection which were "designed to handle relatively simple aircraft" whose airframe seldom was more than 100-200 lb per sq ft, that the national average is up to 400 lb per sq ft, and that the aircraft is up to 400 lb per sq ft, and that the aircraft is up to 400 lb per sq ft.

The fact that the author and inspectors are personally responsible for the complete permit inspection permits other persons from conducting the inspection under his signature, Schack said. This argument is difficult, if not impossible, said, as these individuals as the size and complexity of the aircraft and its systems increase.

In control, he noted, the combined repair system can assign mechanics because of an inspection system that allows delegation of responsibilities within that one organization and the organization is held responsible by the FAA for actions of their mechanics. In the case of single-ownership operating rules have been the more responsible for the shortcomings of his place and using that his aircraft was made

available for required inspection and necessary maintenance.

To combat this, FAA established the progressive system of maintenance in 1959, a basic concept that had been employed by airlines for years to reduce downtime. But Schack pointed out, the progressive system lacks a prescribed schedule for inspection and maintenance of specific aircraft, "a lack particularly significant in the case of the large aircraft with more complex systems, and even more significant in the case of turbine-powered, high performance aircraft."

Development and administration of future maintenance standards, he said, must recognize these facts:

- Number of business and maintenance operations and aircraft for various the number of airlines, whereas the number of aircraft per operator is considerably less than in airlines.

- Business factors affecting business operations against those of the airlines.

- Utilization of individual aircraft.

Keeping these points in mind, he continued, FAA is considering development of a maintenance maintenance system to reduce personnel at the present progressive maintenance inspection system and eliminate the need for the periodic inspection.

Proposed will prescribe specific time limitations for inspection and overhaul and, where applicable, replacement of parts. Initial terms, Schack explained, will be based on the best available in-

formation from the manufacturers, the operation and through records in FAA. Under the Administrative Procedures Act, FAA must publish any proposed rule changes in the Federal Register for comment and for diagnosis. A series of four 15 to 30 day drafts is provided for industry study and comment.

Schack stressed that the new regulations will apply equally to all general aviation operation of a particular aircraft, and model of aircraft, and provide those limitations will be published when operating experience warrants. FAA will monitor each operator's progress to assure that initial time limitations are observed.

Maintaining also will show whether economy or economy in the limitations are consistent with the operator's particular reliability experience, Schack explained. Reliability, he pointed out, will be judged on unscheduled equipment cancellations, flight interruptions, malfunctions as well as other delays.

Soviet Automatic Control Work Impresses Visiting U.S. Scientists

Cambridge, Mass.—Breadth and magnitude of the Soviet Union's effort in automatic control and the top-level support that the government gives to this effort impressed U.S. scientists who attended the recent International Symposium of Automatic Control (ISAC) Congress in Moscow.

As American scientists who attended the congress told the Joint American-Soviet Conference here, their papers appear to have straddled many categories and systems in the laboratory. "It is not clear that their priorities have been evaluated."

Scientists also commented on the lack of reference in Soviet papers to specific industrial applications of the techniques in systems reported. These were seen as references in an Soviet papers in industry applications.

Dr. John G. Gibson of Purdue University also noted that the Russians have not fully bridged the gap between their control theory and industrial applications. But he said that the Russians recently have established five new institutes which are intended to speed the application of automation to large-scale industry. One of these is Kuz, now employs 2,000 persons and the figure is expected to triple in several years. U.S. visitors were told.

Fast ISAC President Harold Chaffin, chief of General Electric Co. told Alexander Wark, chief of the Soviet Union's automatic control facilities and in aviation during the trip did not find the Russians to be backward in applying automatic control technology.

This phase requires considerable work and development of reliability factors, Schack said. You, of course, will be required to keep a continuous history to substantiate the program you are following.

The new scheduling, Schack said, is concentrated in FAA's data toward public safety, but has not been planned solely on accident records or statistics, nor do we intend to wait for such safety to guide our actions.

He added: "While the progress of automatic control operation continues to move these maintenance programs at constant with our past inspection programs, we are aware of the fact that these aircraft are in fact, unscheduled by following a flow of progressive or continuous maintenance rules."

This is itself, emphasizing the need for a more comprehensive rule that is presently provided in Civil Air Regulations.

In fact, Chaffin said, Soviet Russian scientists expressed interest that the U.S. had not yet made use of self-inspection within its industry. Initial U.S. application was to automatic pilots for aircraft and missiles.

Chaffin said that Russian automatic pilot control systems do not appear to be so sophisticated as some in use in the U.S. Dr. Gibson also observed that the Russians appear to lag behind the U.S. in the use of digital control techniques.

Soviet scientists said that Russian English are well versed on new American developments, an automatic control, but in a recent visit to the Soviet Union, progress of translation of all important foreign technical journals.

American visitors also reported that Soviet engineers had put much more time and effort into preparing for the ISAC congress than their U.S. counterparts. Proposals of the papers were made available in advance, but technical delays resulted in American delegates missing their English language versions only a few days before leaving for Moscow.

Soviet scientists were prepared with pre-printed questions following the technical papers. These were directed at Soviet scientists as well as visitors.

The Russians were extremely cordial and hospitable in relations with American scientists, despite the fact that the ISAC congress was held shortly after the U.S. embargo and the blow up of the Soviet meeting.

Prof. Tsiou and Dr. Gibson are in agreement that the Russians are not behind in automatic control technology, but rather because Soviet research is directed by members of the Academy of Sciences, many of whom are now in their thirties or forties.

Scientists also expressed views can become unbalanced with research problems that are no longer important and hence research controls into research areas which are less promising and in favor of the research into Tsiou suggested.

John Loner of Bell Telephone Laboratories said that Soviet scientists appeared to have a more realistic view of their position relative to Western scientists than a few years ago. He attributed this to the Soviet's Sputnik I and subsequent Russian space achievements.

The Joint Automatic Control Congress here was at the Massachusetts Institute of Technology was sponsored by the American Society of Mechanical Engineers and participation by the Institute of Radio Engineers, American Institute of Electrical Engineers, and American Society of America and the American Institute of Chemical Engineers.

Bell Readies Liquid Fluorine Engine Bid

By Michael Yaffe

Bellco, N. Y.—Bell Aircraft Corp. is studying a proposal for the Air Force on a liquid fluorine rocket engine designed for use in an upper stage of an advanced satellite carrier vehicle.

Engine will use hydrazine as the fuel and will produce approximately 15,000-lb thrust. Propellant will be fed by turbo-pumps into a regrettably cooled aluminum thrust chamber. Thrust and exit acids, of the engine also will be fabricated from aluminum drilled with coolant passages. The new engine is expected to have instant availability similar to that of Bell's present Agena model.

Major attraction of the new engine, according to Bell spokesmen, is that it will offer a 30% increase in performance over a liquid nitrogen/liquid hydrogen engine of the Centaur type in the same size class, owing to the high bulk specific gravity of the liquid fluorine-hydrogen propellant mixture.

The new engine, says Bell, could be produced within 18 months also as a backup vehicle, a time period expected to be within the period specified in the anticipated Air Force request for proposals in an advanced upper stage rocket engine.

Backbone reports its complete up-to-date fluorine system, called the Nucleon, has been described in "Flight-weight hardware" and could be proposed for any program that may develop

in this line. In the 15,000-lb-thrust class, the Nucleon was designed as a pressurized system, but Bellco's says it can offer the engine with a turbo-pump feed system.

Bell, which has been working on liquid fluorine engines for the past few years under Air Force and National Aeronautics and Space Administration contracts, disclosed that it has been using large full-scale prototype fluorine engines for the last test at USAF Plant 35 in Monroeville, N. Y., using hydro-gas, hydrazine and ammonia as fuels. In some cases, the engines have been fired into an aquaplane duct to simulate air-blast test, in others, single fired into the air. The exhaust products, including the highly toxic hydrogen fluoride, dissipate rapidly creating no hazardous situation, according to Bell scientists.

At the present time Bell is still carrying out work on its fluorine engine under an NASA contract and is negotiating with Air Force for a new research and development contract that would permit it, among other things, to investigate the use of a hydrogen gas generator to drive the turbine for the propellant pumps.

As its work is done, when Bell has fired the engine with fluorine and hydrogen, the technique has been used to cool the thrust chamber and drive the turbo-pumps. Combustion chamber pressure in these tests has been approximately 180 psi. When the runs were made with hydrazine and fluorine, the pres-

sures were somewhat into the chamber, and combustion chamber pressure was approximately 200 psi. The hydrazine was used to cool the thrust chamber, doing a satisfactory job, says Bell.

The thrust chamber could be made out of steel or nickel alloy, according to Bell engineers, but they feel that the drilled aluminum structure they currently are using is more than adequate. Without change in design in any part of the thrust chamber, the engines have several aerobically through repeated firing. Bell uses a nickel aquaplane through which the propellants are sprayed into the combustion chamber.

Bigger problems encountered in these fluorine engine work, according to Bell scientists, were the development of satisfactory sealing arrangements on the turbine pump and bearing to pump liquid hydrogen without it leaking to hell off. The first problem was solved, says Bell, through a modification of the sealing arrangement on the occupant's Agena pump. The present fluorine pump with contact of aluminum mode surface against an aluminum oval, and carbon against aluminum oval. The oval, a Bell engineer reports, are efficient even after 50 runs of operation.

There is no lubrication problem with the pumps, the company says. The gas law is reduced from the evaporative properties of a per se arrangement. Pumping the fluorine proved to be no problem because the fluorine can be reheated with liquid nitrogen. Preventing liquid hydrogen from boiling off and reaching combustion was a difficult stay. Bell states, however, that it has now solved this problem.

Owing to the hypersonic nature of fluorine system, Bell expects no trouble in involving the engine with rocket expeller at altitude. Initial start-up errors probably will be like that on the Agena. Sequencing start or relay has been in the new engine has been borrowed from the Agena design. Starting sequence is as follows: the turbine is started, pumps are brought up to pressure, propellant line valves are opened, giving almost instantaneous entry of fuel and oxidizer into thrust chamber. Thrust chamber is brought up to pressure within specified time. Thrust sequence would be the same, says Bell.

In the opening of the propellant line valves and entry of fuel and oxidizer into the combustion chamber, Bell reports that it has experienced fluorine levels and laps up to 110 milliseconds with no accompanying problems.



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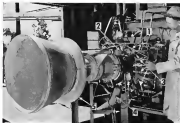
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LIQUID FLUORINE rocket engine developed by Bell Aircraft Corp. is 15,000-lb. thrust class. Above, the engine is being set up for firing with liquid hydrogen. In picture can be seen (1) thrust chamber propellant valve, (2) hydrogen feed line, (3) instrumentation pickup, (4) turbine exhaust attachment and duct, and (5) repetitive starter unit. Combustion chamber, thrust and exhaust nozzle are fabricated from aluminum.





MEMO TO JOHN:

Thank you for your letter in which you express your preference for Kaman helicopters. As you put it:

YOUR
TRAFFIC IN HELICOPTERS. That
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Balloon-Borne Satellite Detector Studied

Passaic, Calif.—A new method of detecting unannounced satellites with high-altitude balloon-borne optical systems is now under development for the Geophysics Research Directorate, Air Force Cambridge Research Laboratories, by Electro-Optical Systems, Inc., and a prototype system is expected to fly next summer.

The balloon-borne telescope will have a telescope, built to the ground with precision against electronic countermeasures and 360-deg hemispherical coverage. Electro-Optical Systems scientists emphasize that it is not a tracking device. It is intended to scan the sky and acquire a satellite that has not been previously announced or on which no tracking information is available.

Electro-Optical officials say the system can be used to detect nuclear bomb-bearing satellites or subsonic reconnaissance or communications vehicles. With some modifications the unit might also be used for ballistic missile early warning.

Heart of the system is a 20-in. modified Bausch telescope suspended from a 200-ft-dia Air Force balloon at altitudes of approximately 20 miles. At this height, solar radiation reflected from unannounced satellites can be detected over angles of several hundred miles. Vector and position information of the acquired satellite will be transmitted to ground receiver stations.

The telescope and its electronic package will weigh about 1,000 lb., will be suspended by a 700-ft cable from the underside of the balloon, and will occupy the sky at observation angles between 15 and 75 deg. At the same time, contractors require 500 deg. almost complete hemispherical coverage is provided.

An economic advantage over satellite-borne detection systems is the elimination of expensive booster costs. Additionally, the balloon-borne system can be oriented to earth by pivoting the balloon, requires adjustments or repositioning.

A complete detection system would employ a series of balloon-borne telescopes placed at predetermined areas to provide satellite detection over a desired region. Deployment of the system in all parts of the world would provide the necessary 24-hr illumination for around-the-clock surveillance.

Design of the specially modified Bausch telescope will emphasize simplicity, accuracy, to temperature extremes and high accuracy. Elements of the telescope will include two concrete plates to house a spherical mirror and a detector mosaic.

Radiation entering the telescope passes through the first or acquire concrete plate and flies through the second lens with concentric spherical surfaces. The radiation finally strikes a spherical mirror which focuses the light upon a detector mosaic supported on the rear of the second concrete plate.

The detector mosaic was designed to meet problems of background scattered radiation the available reflected radiation from the satellite, the signal-to-noise ratio of the best detector cells available, scanning rates and many other factors. A pattern of 50 individual detectors was selected as a compromise between cost and range. Each cell will consist of a lensoperated vacuum tube with lens into which a lead cathode detector is attached. Diameter of each lens is 2 mm and the width of the lead cathode deposit is about 1 mm.

Radiation detected by each individual cell will be channelled to a common prompter and discrimination device.

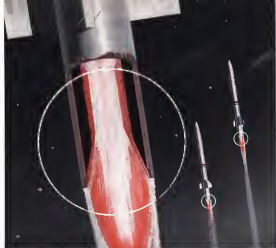


Soviets Detail Sputnik V Dog Cabin

Details of Soviet Union's Sputnik V, which successfully orbited and returned two dogs to earth (APR. 28, p. 31), are shown in these Russian drawings (top p. 31). Above is the air tight cabin which housed the animals showing: (1) air supply cylinder (2) oxygen cylinder mechanism (3) radio direction finding unit (4) battery for heating test tubes containing various nutrients (5) accelerometer battery (6) unit of speed electronic apparatus (7) oxygen supply (8) pump to maintain cabin atmosphere (9) air tight cabin (10) microphone (11) RDT antenna (12) intake and exhaust valves (13) television camera (14) mirror (15) ventilation system (16) antenna device for combined finding of the dogs. Sputnik V weighed 16,120 lb. and attained a ten-orbits orbit with a perigee of 190 mi. and apogee of 219 mi. Cabin mounted on the 15th day.



41



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to freight configurations and on Feb. 7, 1964, in large size for engineering aircraft carrier.

• **British Overseas Airways Corp.** carried \$14,954,294 loss in cargo operation during the first six months May 31, 1960, expects to earn \$17,133,000 in its current fiscal year. BOAC loaded 2,119,894 lb. of North Atlantic cargo during the first six months of 1959; this increased this total 41% during the first half of 1960. Workload total of 1,835,402 lb. represents a 56% increase, while contained total of 1,435-465 lb. was up 29% over 1959. BOAC has no all-cargo aircraft at present and no concrete plans to acquire these. Nevertheless, it predicts that in 1960 cargo traffic will approach 7.5 million lb. In 1959, BOAC's North Atlantic freight figure was 4,514,520 lb.

• **Canadian Pacific Air Lines**, which does not operate from U.S. cities to Europe, earned 15,155 lb. of cargo on its route from Montreal to London, Madrid and Rome during the first half of 1960, 205% more than in 1959. CPA estimates that it will move 35,000 lb. of cargo on its this route in 1960, it loaded 9,080 lb. in 1959. Worldwide cargo gross revenue in 1959 was \$1,916,592, but CPA expects 2,240,540 in 1960. Carrier's plans to introduce all-cargo aircraft are "indefinite."

• **ITA** had reported one of the three declines in American World's carrier workload during the first six months of 1960. IAE 1-4% from the 1959 level to 200,979 lb. Despite this, the launch volume reported an overall 14% gain in its first half freight flow of 615,900 lb. In 1959, it carried 1,107,545 lb. across the North Atlantic.

• **Reada**, the Spanish airline, earned 118,356 lb. during January 1960, expects to move 150,722 lb. during 1960, for a 65% increase on its North Atlantic routes. There has no scheduled plans to purchase freighters.

• **KLM Royal Dutch Airlines**, for 12 years an operator of all-cargo aircraft on North Atlantic routes feels that in 1960 it will earn about 15 million lb. of freight, a million more than it earned in 1959. KLM's first-half 1960 total of 6.6 million lb. represents a 35% increase over last year, when 4.6 million lb. were moved. Workload freight flow rose up 20% in 1-1 million lb. the workload increased 40% to 1.1 million lb. According to the carrier, the first of its DC-7's now being converted will be introduced in North Atlantic service in late October. Then KLM will depend on its single DC-4, but active all fleet of five Lockheed 1049Hs. Operating since April 16, KLM earned 3.2 million lb. of cargo on passenger flights and 3.4 million lb. on freighter flights in the first half of 1960. Seasonwide cargo revenue of 21.5 million was reported in 1959.



Los Angeles Airways Receives S-62

Sikorski S-62 single rotor helicopter has been delivered to Los Angeles Airways (LAA Sept. 12 p. 47). The 812 passenger amphibious aircraft will be the first helicopter-powered helicopter scheduled airline service. The S-62 is leased by LAA, which has ordered the S-62 in 1960, the 1961-62 delivery.

525 in flow is expected in 1960 period.

• **Lufthansa German Airlines** earned 2,449,155 transatlantic pounds in the first six months of 1960, 59% more than it earned in 1959's first half. East-bound traffic was up 95% to 1,387,017 lb., workload increased 51% to 1,857,322 lb. Average weekly capacity, one contract placed during the period in Lufthansa placed in both 747-420 and two L-1049 freighters. Airline's 1960 passenger volume is 5.1 million lb., more than double the 2,544,899 lb. moved during 1959. Lufthansa earned \$60,044 lb. of freight in all-cargo aircraft, 1,488,242 lb. in passenger flight during first half 1960.

• **Lufthansa German Airlines**, the only scheduled carrier on the North Atlantic not an IATA member, predicts a 57% increase in 1960 when its airline begins to carry 460,800 lb. It earned 141,445 in 1959. First six months figures show Lufthansa moving 190,451 lb. of which 72,675 were transatlantic and 117,776 continental.

• **Pan American World Airways** led North Atlantic carriers in cargo as well as passenger traffic in moving 3,230,000 lb. of freight during the first half of 1960. This represents a 35% increase over 1959's total of 2,425,000. Breakdown of 1960's first half total shows workload cargo up 70% to 4,391,000 lb., transatlantic cargo up 29% to 3,965,000 lb. 4,217,000 lb. of cargo on freighter flights and 1.4 million lb. on freighter flights in the first half of 1960. Seasonwide cargo revenue of 2,185,567 lb. in 1960's first six months, 1,811,214 lb. in the same

schedule, Pan American predicts first nine months 1960 when it will be earned in 1960 at 93% more than the 13,341,000 lb. earned in 1959.

• **Quantas Empire Airways** posted an overall 21% increase after the first six months of this year, with a 14% 1959 in first-half cargo earned 142,000 lb. in 1959 to 160,000 lb. in 1960. Total transatlantic cargo from a 205% increase, which dropped from 142,000 lb. in 1959 to 104,000 lb. in 1960. Total transatlantic cargo from a 205% increase, which dropped from 142,000 lb. in 1959 to 104,000 lb. in 1960. Total transatlantic cargo from a 205% increase, which dropped from 142,000 lb. in 1959 to 104,000 lb. in 1960.

• **Scandinavian Airlines System** plans to introduce an additional number of DC-7's compared to before the summer of 1961, already operates the freighter on its route European routes. SAS estimates that it will move 5 million lb. in 1960, building with a 22% growth rate. During the first half of the year loaded 1.6 million lb. transatlantic and 1.4 million lb. continental recording gains of 21% and 20% respectively. Airline weekly capacity rose from 200,000 lb. in 1959 to 238,000 lb. in 1960.

• **Swedish Airlines World Airlines**, with two DC-7C freighter conversions due this fall, expects a 96% increase in North Atlantic cargo during the first half, the peak growth rate among the major carriers. The airline accounted for 2,185,567 lb. in 1960's first six months, 1,811,214 lb. in the same

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period of 1919. East and westbound cargo capabilities for the first half of this year was 5,112,000 lb. Last year it was 1,662,200 lb. First Sahara jet service began Jan. 13.

• **Belmont freights**, which estimate 2.7 million lb. in 1950, are based on a 20% gain over 1949's total of 2,083,664 lb. The carrier operates one DC-6A freighter on the North Atlantic and two more in Europe, but has decided no decision on acquiring additional off-charge aircraft.

• **Trans-Canada Air Lines** predicts only a 14% increase in North Atlantic cargo for 1950 and looks for a revised total of 1,166,538 lb. in 1949, TCA's revised 2,176,320 lb. During the first six months of 1950, TCA's eastbound cargo was down 23% to 561,785 lb. its westbound cargo up 15% to 681,305 lb.

• **Trans World Airlines**, which expects a 51% increase in 1950, North Atlantic cargo, plans to introduce the first of its Lockheed 1649 freighter conversions this month on its route from New York to London, Paris, Rome, Milan, Frankfurt, Zurich and Geneva. Meanwhile, two 1049Hs are being used to haul transatlantic freight. Weekly average airlift capabilities of TWA now from 300,000 lb. in June, 1949, to 900,000 lb. in June, 1950. The carrier's first half total of 1,340,491 lb. represents an 87.5% increase over 1949's first six months when 1,798,770 lb. were moved. Bookings show a 114% month-to-month increase and a 37% month-to-month gain.

In 1949, TWA carried 4,586,600 lb. of cargo, that this year it will carry 8.2 million lb. and run 515 million system-wide from freight service.

To some observers who expected the new jets to dominate transatlantic cargo traffic this year the share of business captured by converted freighters is surprising. These major factors apparently are responsible for the fact that freight-carrier cargo is increasing more rapidly than cargo carried by passenger aircraft.

First is the influx of capacity from the freighter traffic. With the new plane market for DC-7s and Super Constellations already soft, carriers are taking a hard look at the earning potential of the big passenger-line transports, many of which already are written off. If North Atlantic freight flow continues to grow at its present pace, some conversion orders seem inevitable.

Shippers also realize that jet schedules are not published as passenger routes, which freighter schedules usually are timed to deliver cargo at the local-built or pickup point to meet rail and truck connections. Freight forwarders think in terms of delivery the first is moved meaning that departure, with the emphasis on "moving." Despite the jet's speed advantage, freighter flights often are one first morning deliv-

ery at prime European gateways when the jet comes.

Because these schedules have been worked out by the carrier's cargo sales departments, and because the freighter can only turn a profit with relatively high cargo load factors (while an airliner build is not an unwise penalty to a passenger-carrying jet), most airlines are concentrating their cargo sales efforts on freighter flights.

Optimistic forecasts of North Atlantic cargo growth also are supported by the IATA's new structure, which has kept the cost of international shipment considerably higher than comparable air freight rates within the United States. Carriers, accordingly—according to Prof. Stanley H. Brewer, transportation expert at the University of Washington—international rates probably will drop faster than domestic rates, thus decreasing prospective transatlantic shippers.

An airline's explore volume movement, back-haul traffic stemming from overseas charter and delayed cargo—both of which the domestic jet trade can be expected to absorb. Acquisition of surplus DC-7s and Super Constellations by supplemental carriers also will furnish IATA airlines with a potential addition to local rate competition in the face of mounting competition for cargo in the expanding North Atlantic market.

Coach Fare Increase For Jets Requested

Washington—First more intensive hearings on coach fare panel United Air Lines is asking the Civil Aeronautics Board for increased airport transport coach fares.

American, Trans World, Continental and Northwest airlines filed with the CAB for jet coach fare increases designed to bring them within 75% of first class fares.

All five carriers stress the fact that the type of service offered in coach sections of their jet-borne transport does not differ to any great degree from that offered in first class sections. Thus, differences of as to 50% between first class and coach fares are considered as unreasonable and excessive by the airlines. The new tariffs would bring that difference down to a maximum of 25%.

In other tariff actions, the CAB suspended tariffs on air of near segments filed by on Delta Air Lines's system calling for an coach fare increases, which would exceed the coach fare of 75% of the first class fare as provided in the Board's domestic coach policy. The Board deferred action on the remaining three segment increases pending further analysis.

Eastern Proposes Low Fare Service to CAB

New York—A long-haul non-stop, reduced fare service designed to be competitive with long-haul motor transportation has been proposed by Eastern Air Lines as an application to Civil Aeronautics Board for a new Pittsburgh-Miami route.

To get the traveler away from his automobile as economy but trip, Eastern plans to offer Lockheed Super Constellation service at \$40 one way under the new plan. Passengers who take advantage of the high density, non-stop or interrupted flight will be able to buy tickets and proceed directly to their flights without making unnecessary air-choosing in.

The plan represents a 25% reduction from lowest current coach tariffs. Under the plan, tickets for seats on the 97-passenger Super Constellation will be sold up to 90 days in advance. Once tickets have been disposed of, the flight will be sold out. Constellations must be made more than 24 hr. in advance of departure time. Late cancellations or no-shows will be entitled to refunds.

Eastern offers this comparison of highway and air transportation between Pittsburgh and Miami in considering the proposed new fares:

Eastern	Western	Midway	Eastern
First class	First class	First class	First class
Coach	Coach	Coach	Coach

Two-Year IATA Rates Proposed by CAB

Washington—Civil Aeronautics Board, in a letter to IATA's Council last week, urged that passenger fares and cargo rates set by the International Air Transport Association be effective for two years instead of one.

Transportation International "hardness" and "unanimity," the Board suggested that carriers opposing the two-year IATA rates be required to give notice of an intent to request at least eight months in advance.

This proposal, CAB said, would ensure that airlines "would not be required to change fares or rates to which they no longer accorded." U.S. carriers overwhelmingly have concurred with the Board's suggestion.

Specifically, a carrier wishing to void an IATA rate established for two years beginning Jan. 1 would have to give notice no later than Sept. 1. This would convene a special meeting of IATA's Traffic Conference with its agenda limited to the dispute rate.



Convair 440's 440-84 "Delta Queen" sets new coast-to-coast speed record on Delta's scheduled flight.

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*Based field time Anchorage, Alaska and Phoenix, 2 hours, 10 minutes, 24 seconds. Average speed 667 mph.

Airline Traffic—July, 1960

	Revenue Passengers	Revenue Passenger Miles (RPM)	Passenger Load Factor %	U & M Ton-Miles	Express Ton-Miles	Freight Ton-Miles	Total Revenue Ton-Miles	Over-all Revenue Load Factor %
DOMESTIC TRAFFIC								
American	410,791	344,791	87.5	1,479,821	940,114	9,476,707	10,415,632	88.9
Boeing	113,481	91,971	80.9	414,218	156,371	2,014,191	2,180,760	81.6
Capital	307,764	333,764	108.4	919,840	399,379	491,844	1,311,063	107.9
Continental	121,291	90,303	74.4	297,130	121,491	1,402,428	1,620,049	81.6
Delta	399,545	344,571	86.2	1,486,281	319,033	3,134,005	4,939,319	87.3
Eastern	400,992	342,126	85.3	1,140,493	444,694	1,379,391	2,964,578	86.7
Norfolk	150,139	105,549	70.3	291,303	20,742	911,493	1,223,538	70.6
Northwest	132,817	114,194	86.0	1,344,211	35,433	3,145,793	4,525,437	86.0
Republic	19,819	191,696	96.6	476,344	377,747	1,316,263	1,990,354	96.6
Texas World	420,622	447,719	106.4	1,409,455	945,911	1,516,961	3,872,327	106.4
United	381,224	328,134	86.1	2,324,775	937,911	2,729,329	5,982,015	86.1
Western	193,684	150,123	77.5	201,001	19,844	319,103	5,380,700	77.5
INTERNATIONAL								
American	10,116	15,019	148.6	6,700	—	397,491	1,230,391	148.6
Boeing	6,437	15,012	233.2	—	—	176,013	1,540,791	233.2
Continental	19,099	2,070	10.8	1,400	—	6,419	1,640,791	10.8
Delta	5,311	4,548	85.6	—	—	27,018	1,010,791	85.6
Eastern	10,899	10,304	94.5	77,277	—	194,315	4,450,791	94.5
Northwest	17,410	2,634	15.1	—	—	3,932	320,640	15.1
United	5,744	5,070	88.3	3,190	—	1,467	304,691	88.3
Western	10,314	10,374	100.5	1,128,841	18,179	472,391	5,970,140	100.5
For America	—	—	—	—	—	—	—	—
Alaska	6,367	6,464	101.5	—	—	150,440	3,116,442	101.5
Atlantic	143,001	342,364	239.4	1,400,391	—	4,439,711	6,180,491	239.4
Latin America	119,201	149,264	125.2	633,091	—	1,147,549	2,910,791	125.2
Pacific	36,410	121,836	334.8	1,403,201	—	17,700,419	19,513,791	334.8
Panama	18,749	19,194	102.4	80,453	—	418,135	2,066,120	102.4
Recess	—	—	—	—	—	—	—	—
Spain	—	—	—	—	—	—	—	—
Texas World	49,418	149,419	302.2	1,127,149	—	1,224,811	3,110,389	302.2
United	20,162	50,119	248.7	104,301	—	176,622	4,484,410	248.7
Western	4,174	4,091	97.8	6,549	—	26,410	309,640	97.8
LOCAL SERVICES								
Alaska	61,709	12,349	19.8	14,499	24,457	40,411	1,890,791	19.8
Continental	21,812	3,347	15.3	4,394	3,391	10,555	341,647	15.3
Delta	18,110	5,902	32.6	1,120	3,097	8,100	340,791	32.6
Eastern	69,479	8,367	11.9	34,156	10,447	44,411	888,800	11.9
Northwest	67,499	3,508	5.2	5,491	12,744	—	388,791	5.2
Republic	21,100	18,074	85.6	12,019	17,106	17,099	1,094,440	85.6
Texas World	67,499	16,344	24.2	27,190	46,412	26,449	1,790,500	24.2
United	67,112	8,166	12.2	1,604	34,108	40,791	1,094,440	12.2
Western	44,260	10,002	22.6	16,409	4,126	6,501	1,094,440	22.6
Florida	41,207	6,141	14.7	11,197	12,191	10,799	890,440	14.7
Portland	2,404	4,410	183.4	4,409	3,204	4,409	44,400	183.4
Texas World	21,140	6,000	28.4	19,411	10,412	26,411	643,800	28.4
New York	37,071	9,367	25.0	11,367	6,410	34,410	590,440	25.0
RAVING LINE								
Alaska	41,410	4,400	10.6	2,400	—	9,407	320,791	10.6
Boeing	36,100	14,107	39.1	12,407	—	103,110	1,440,791	39.1
CANOE LINE								
American and American	—	—	—	—	—	—	—	—
Boeing	7,100	12,100	17.0	14,407	40,100	271,004	370,104	17.0
Continental	—	—	—	—	—	—	—	—
Delta	—	—	—	—	—	—	—	—
Eastern	—	—	—	—	—	—	—	—
Northwest	—	—	—	—	—	—	—	—
Republic	—	—	—	—	—	—	—	—
Texas World	—	—	—	—	—	—	—	—
United	—	—	—	—	—	—	—	—
Western	—	—	—	—	—	—	—	—
WILCOFFS SERVICE								
Chicago	29,000	44,000	151.7	1,201	—	—	48,291	151.7
Los Angeles	6,404	10,404	160.8	4,404	1,100	—	21,740	160.8
New York	16,400	26,400	161.0	7,797	1,399	—	36,640	161.0
ALASKA LINE								
Alaska	11,407	6,379	55.5	46,394	5,444	154,744	3,467,407	55.5
Alaska	2,100	704	33.5	2,391	—	6,407	86,647	33.5
Continental	2,100	491	23.4	5,070	—	16,221	107,420	23.4
Delta	4,407	1,407	31.9	3,119	—	16,799	81,740	31.9
Eastern	4,400	1,003	22.8	2,419	—	74,401	361,400	22.8
Northwest	12,412	14,119	113.6	11,144	7,331	456,817	3,460,390	113.6
Texas World	4,407	1,407	31.9	3,119	—	16,799	81,740	31.9
United	1,407	1,407	100.0	231	—	1,109	1,104	100.0
Western	4,407	1,407	31.9	3,119	—	16,799	81,740	31.9
Alaska	4,407	1,407	31.9	3,119	—	16,799	81,740	31.9
Alaska Air Transport	17,118	727	4.2	727	—	947	79,430	4.2

*Not available. *No operations in July. Compiled by AVIATION WEEK from airline reports to the Civil Aeronautics Board.

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AIRLINE OBSERVER

►Nab of the Trans World Airlines financing deal, appears to be the effort by the financial group to have an independent director, or directors, named to the owner's board. Howard Hughes, who can elect TWA's board through its 70% stock ownership, is far a chairman's opponent. Speculation in New York financial circles is that financing will be arranged, but that there may be changes in the syndicate members and that Hughes may pay a higher price in interest rate or in added equity financing than that realized in the original \$440 million package. Hughes' financing with Concor is increased, with Hughes offering to Concor that specific fuel consumption of the Concor's 20,000 engines is too high on the Concor 850 and seeking to have the direct 850s working on the Concor for TWA modified with turbofans. An order for Concor 600s for TWA also is scheduled in the negotiations (AW Aug. 12, p. 50).

►High cost of aircraft fuel increases is stimulating an increase in a 10% increase plan by many airlines. Qantas Airways is now self-insuring its entire fleet and by the end of 1979 had accumulated a reserve of \$1,895,000 for this purpose. The Australian World Airways also is working toward an estimated \$30 million reserve for partial coverage of its fleet. Northwest European Airlines, which had a Fuel 1979 appropriation of \$10,000 for this purpose, has increased this sum to \$2.4 million for the current year.

►Civil Aeronautics Board has taken steps to confine the length of briefs submitted by airlines. Airlines are limited to briefs of no more than 70 pages, but Board members complained that the airlines have been submitting single-paragraph documents in which type sets longer paragraphs and short stories attached. A new stipulation amendment now holds briefs to double spacing, with any additional charts or exhibits considered a part of the 70-page limit.

►Federal Aviation Agency is exploring the possibility of changing Vortex streamers across the Atlantic. Next month a Vortex-equipped U.S. Coast Guard cutter will begin preliminary tests along the East Coast for the streamer, which will be followed in November by a three-hour test in the North Atlantic. FAA hopes the resulting successful trial will result in a reduction of current 10-minute separations required for transoceanic flights.

►Eastern Airlines and the Redkey Express Agency are now offering shippers a new air freight, surface express service designed to reach cities without airports. Shippers will receive local pickup and delivery as part of a single air freight bill, based on a combination of air and surface rates of the two carriers.

►Eastern Airlines obtained an average 10% cost reduction of 70% during Fiscal 1979 with a \$20-a-day reduction in DC-4B and DC-4B equipment.

►Export-Import Bank has agreed to loan \$8.6 million to DC-4B and DC-4B aircraft to be put toward purchase of two Boeing 707 transports. Scheduled for shipment at a previous period, the loan covers the major portion of the cost of airframes, engine parts and ground equipment. Balance of the cost is being financed by EIA and Boeing.

►Japan Air Lines last year carried 41% of the 65,000 passengers on the Central Pacific air routes, about 6% of the \$5,000 on the Northwest Pacific routes and nearly 15% of the 125,000 on the Southeast Asia routes, according to a Department of Commerce survey. Traffic levels on the Pacific routes were made in competition with five other airlines.

►KLM Royal Dutch Airlines has scheduled its first DC-7F all cargo aircraft for a five-day tour of the U.S. in September. DC-7F, already will visit Los Angeles, San Francisco, Chicago, Philadelphia and Washington, D.C. with an order of typical cargo handled by the airline and a group of air cargo experts from Holland, England, Italy and Switzerland.

►Rapidly growing operations of Russia's Ministry of Foreign Trade publications is being used to promote Aeroflot's international services in other countries. Moscow was once reluctant to give Aeroflot timetables to foreign countries on a regular basis. Recent work of the ministry's press, Vostochnaya Telegramma included a separate, full-color Aeroflot schedule in English, advertising Europe-Asia flights through Moscow.

SHORTLINES

►Alaska Airlines' and Hawaiian Airlines' recently filed tariffs for general increases in ordinary passenger fares of 4% plus \$1.00 per ticket, which would have become effective last week, have been suspended by the Civil Aeronautics Board pending investigations.

►Civil Aeronautics Board Chairman F. D. Mason has recommended that the former air carrier board of Lines Aeronautiques du Nicaragua, S. A., be dissolved for three years. The Nicaraguan airline serves the U.S. at Miami from Managua via the intermediate point of San Salvador, El Salvador.

►Eastern Air Lines reports an increase of 21% in cargo tonnage and 10% increase in dollar revenue for air freight in the first six months of 1979. EAL carried 23,095,187 lb of air freight 10,190,120 ton-miles in the first-half period, against 19,847,952 lb of cargo carried, 8,947,728 ton-miles in the first six months of 1978. Air freight revenue for 1978 was \$2,618,209. Also during the first half of this year, EAL moved 143,147,371 lb of air express, 79,713,482 lb of air mail and 5,150,015 lb of company first class mail.

►Federal Aviation Agency is instructing more than 100 FAA safety inspectors in repetitive pilot training in operation of turboprop, turboprop and other higher performance aircraft. Purpose is to be sure inspectors have the same knowledge and skills as the airline pilots they are inspecting. Aircraft in the program are Boeing 737 series, Douglas DC-8, Cessna 440, Lockheed Electra, Western Viscount series, Fairchild F-27, Convair 440, Lockheed Constellation series and Armstrong Whitworth Agony. Other aircraft will be added later.

►Japan Air Lines has scheduled Car. 1 at starting date, its two-weekly Dumbo to DC-4B freighter service between San Francisco and Tokyo, via Honolulu. The plane to convert two of its Douglas DC-4B freighter configurations to an freight aircraft as soon as the company's Douglas DC-4B freighter aircraft have all passenger flights. The DC-4B has a capacity of 13,000 lb and the DC-4B will have a payload capacity of 30,000 lb.

►Transocean Air Lines' application for acquisition of Air Jordan Co., Ltd., has been denied by the Civil Aeronautics Board at the request of Transocean. The U.S. carrier informed the Board that it had disposed of all its rights, title and interest in Air Jordan.

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FAST ACTION sequence shows the various stages of inflation of a flexible re-entry vehicle which could operate from a space platform in controlled return to earth.

Echo I Advances Flexible Spacecraft Tests

By Edward H. Kolkman

Langley Field, Va.—National Aeronautics and Space Administration tests the Echo I experiment as a realistic evaluation of theories for putting uniquely structured re-entry vehicles into space after they have passed through the atmosphere.

The 100-H. Echo inflatable sphere (AW Aug. 27, p. 50) is considered the answer for a uniquely lendless variety of flexible spacecraft as well as for extension of worldwide communications. Space Vehicle Group at Langley Research Center already has done basic design work, including wind tunnel studies, on inflatable lift vehicles, airships, blimps, solar collectors, ocean buoys and manned orbital laboratories.

Industry interest in the fundamental concepts of flexible structures as zero-orbit-then-communication has been evident in a number of company proposals for such structures. For example, G. T. Scheldahl Co. of Northfield, Mass., which manufactures Mylar spheres for NASA, has an extensive "lathflow" program under way to determine best design and methods for making

ing a positive communications reflecting rigid.

General Electric Co. has designed inflatable "antennas" in emergency spacecrafts to replace rigid structure, inflatable, rigid space vehicles.

Scheldahl work will include study of



RECTABLE structure model was used at Langley Research Center for wind tunnel studies of static loads. Inflatable globe would be 120 ft long with 70 ft span.

existing vehicles by foam, photo-clastic resins, metal cathodes, electrostatic charges and stiffening metal mesh.

NASA studies are aimed at providing functional spacecraft designs with real significance based on mission rather than dictated by booster capability. Rigid structures imposed to the size of a booster are limited in weight and use, and their present effects on inflatables. Flexible structures, characterized by very light weight materials such as Mylar, could be folded and packaged in relatively small containers and expanded into massive, rigid structures in space.

NASA, too, light, waisted vehicles are favored by dog at higher altitudes where they avoid the atmospheric drag, thus avoiding re-entry heating problems. The agency's research extends to studies of materials requirements so that acceptable heat shielding could be included in a flexible, manned re-entry glider.

Members in Echo inflatable-frames and Mylar with thickness of 0.005 in.—are acceptable for some re-entry spacecraft applications but not for re-entry vehicles since it is expected to have to use on re-entry. Precision techniques for folding, unfastening and pack-

aging, developed from pressing the 300 ft. payload, are applicable generally to all large expendable vehicles, according to William F. O'Sullivan, Jr., Space Vehicle Group head.

O'Sullivan also leads Langley's Echo group, which designed the 100-H. sphere and cleared the room for packing the 11,000 sq. ft. sphere into a container with 26-in. diameter Payloads are packed by employees from space vehicles, requiring various and unusual services still.

Sphere is mounted at Langley in 100 in. square container from Scheldahl with all 51 pins sealed except one. At this point, the vehicle is flat and is about 155 ft. long.

Sphere then is folded in two places, unfastening pins, secured under seats and pins are sealed and final made. About 245 pins hold it in place while the vehicle is folded out for final use. Expansion and to show inflation when it goes into orbit.

Packing process involves four air extractions first in hand, pressure reduced by vacuum machine before packing into container and final two when payload expands 45 ft. in a pressure chamber. Each pin is packed with a nitrogen hemisphere in special facilities. The nitrogen-filled container has straps extending from joints to register to provide paths for air escape.

Container Tests

Environmental vibration tests of completed payload are held at Langley, and the container then is sent to Wallops Station for balloon tests. If out in ball, the container has weights added to top hemisphere, which is three pounds lighter than bottom. After shake and balance tests the hemisphere is pinned by 72 holding straps placed over a linear strap, which separates them in orbit.

Reinforced air pressure in the sphere when the payload hemisphere is inflated is 1.5 mg. of mercury, enough to begin the inflation process. Although unfastening pins were good to sustain Echo inflation, NASA designed a compressed nitrogen system to expand Echo's inflation. Two attempts to inflate 12 ft. Echo's inflatable sphere failed because of booster malfunctions.

NASA is considering combinations of spinning and mechanical means of space vehicle design with inflation. Centrifugal force on spinning could inflate large waisted airships, gliders launched as cylindrical packages. At Langley, scientists have examined an existing laboratory using compressed gas to expand compartments like a telescope. Solar collector power source would look much like an umbrella with rigid members automatically folded into place.



COND inflatable container (below) is made ready for the 100 ft. static test sphere. Nitrogen load requires eight packages but 26.5 in. dia. Cotton straps provide paths for support or to escape during expansion. Folding pins (above) were developed at Langley Research Center and is applicable to shaped vehicles as well as spheres.



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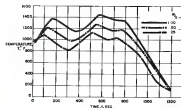


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TIME HISTORY of the temperature recorded during the cruise of a flexible wing glider is shown above for three wing loadings (x/2). Wing loading of 1 g/ft is considered possible now and advances in the technique of making high temperature glass shells will lead toward wing loadings of much less than 1 g/ft, according to current estimates.

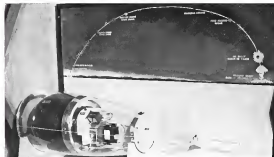
and controls problems have been solved with the flexible wings. In the recent NASA report, *Rept 60* and three other papers, John C. Lewis, Delmar R. Croon and Robert T. Tinker, described the following conclusion: Results of this study indicate that the flexible lifting-surface concept may provide a

lightweight, controllable, adaptable, re-usable space vehicle.

For public discussion of the flexible, reentry gliders, which are similar to penicillins in construction, was held at least a year ago at the bi-annual symposium of the Langley Research Center.

Several other uses have been proposed

- for flexible lifting surfaces. These are:
 - Auxiliary wing which could be folded in a long thin container on top of a supersonic aircraft and released at low speeds to increase wing area for landing and reduce approach and touchdown speeds.
 - Auxiliary wing to aid in the release of launch loaded aircraft. Auxiliary wings of this type could be retractable or jettisonable.
 - Recovery of large first stage boosters through the use of flexible wings which will fold into a small area and will not produce any lift force during launch.
 - Emergency wings for use with various aircraft and landing aircraft.
 - Precursor dropping of personnel and cargo.
 - Use in the case of a flexible wing on reentry vehicles to lighten weight and wing loading loss. This can be accomplished with laminar materials possible because the loads are all tension loads.
- Light Wing**
- Initial estimates of the weight of a single-use cloth or paper which is practical for the wing is about 18 lb per sq yd when mixed with a high compression, fibrous material to make it non-porous. Using this value, a wing with inflated leading edges two feet in



Nuclear Warhead Model Displayed by AEC

Model nuclear warhead section is an modified design and representing an obsolete weapon. Designed and developed by the Atomic Energy Commission it is a solid-state and fuel to components of an obsolete but the method here and shown here over a predetermined point in the trajectory of a missile for testing long. Alternatively, a solid line can start the firing sequence. After proof of the one several points among devices and crystal impact sensing devices to initiate firing. Weapons also devices are also used to prevent premature firing.

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distance, without shroud lines and an area of 1,500 sq. ft. would weigh about 250 lb. The wing weight would go up to about 700 lb. if the area were doubled.

The potential advantage of this vehicle is that for a total gross weight of 1,600 lb. there would be 2,300 lb. available for capsule structure and crew to be saved under the flexible wing. The capsule structure is protected the time during reentry would be relatively light because of the low re-entry temperatures.

In contrast, a Mexican type re-entry capsule requires a gross weight of about 1,400 lb. to assure a 160 lb. man through a re-entry during which the temperatures are several times higher.

The weight advantage of the flexible wing glider is expected to improve as experience is gained in meeting high temperature glass fibers into cloth. Glass cloth themselves can be lighter than metal mesh in the same temperature environment.

Control of the flexible-wing glider is effected by adjusting the length of the shroud lines. For instance, a right turn is made by raising the line to the right hand side of the capsule.

Stability of the flexible glider at its maximum speed proved to be very good. The three related conditions which form the still had and leading edges for the glider did not show a tendency to flutter, and the flexible membrane between them also remained steady.

The flexible concept of conventional parachutes at supersonic speeds have been shown to have many materials out of limits of supersonic speeds. Typical of these materials are "bumping" and "spinning" which keep the parachute from extending fully and produce a free falling drag force.

Deployment

Deployment of the flexible wings at supersonic speeds has been found to be practical using several techniques, including separating the wing out of the back of a cylinder or opening the top of the cylinder.

Lift drag ratios for the wings have been shown to be about 1.0 in tests to date, which have not been made under upstream conditions. This figure is expected to improve, especially when cloth with less porosity is available.

Recovery of the flexible-wing, low wing loading glider into the atmosphere will seem at such a high altitude that accelerations will be very low due to the low air density. A typical re-entry weight start about 400,000 lb. altitude at about 15,000 mph, and the glider with 1.0 g/w wing loading would have slowed to supersonic speed before it reached 150,000 ft. The wing-loading accelerations experienced would be less than 1.7g.

Upper-Atmosphere Rocket Probe Program Accelerated at Eglin AFB

Eglin AFB, Fla.—Upper-atmosphere sounding rocket firing programs are accelerating here as USAF Air Proving Ground Center moves deeper into utilizing its facilities and talents toward a growing space and missile mission capability.

Eglin now is the site of most USAF space probes, efforts here now backing up other Air Research and Development Command's programs where long-range planning and establish the requirements to maintain mission accomplishment. Major projects handled here are developed at Wright Air Development Division, Wright Patterson AFB, Ohio and a detachment of the Air Force Research Division (AFRD), L. C. Hancock Field, Boling, Miss. Space probe firings are conducted by AFRC's High Altitude Test Vehicle Branch utilizing basic, instrumented sites on the Eglin Golf Tour Range off the southwest Florida coast.

Rocket Firings

Rocket firings are conducted from Santa Rosa Island, impacting in the Gulf of Mexico from 35 to 250 mi. off the southwest Florida shore, the vehicles tracked throughout their trajectory by radar, television and tracking camera and data received by Eglin.

Six rocket research flights are given the bulk of sounding studies including Nike-Cajon, Nike-Ap, Arrow-19 and 930, Cora and Bion.

Project Finley

Nike-Cajon has been scheduled as Project Finley, currently being carried out here to gather data on artificial aerosol cloud models in the release of elements or detection of explosives at high altitudes to study long-range communication capabilities, infrared phenomena and the behavior of the upper atmosphere is affected by this artificial disturbance. The Nike-Cajon is fired some 160 mi. high to create a point wherein cloud is charge of instruments—and 28 sec. later a Nike-Ap is fired through the cloud. Nike-Ap carries a 70 lb. payload of sensitive elements, exposed to releasing the nose of the rocket during ascent. Data obtained is transmitted to the ground during the objectives of these studies. Within 33 firings, have been data on the plasma sheath that sometimes holds up on rockets and causes communication blackout.

The test conducted with the Nike-Cajon has been as effort to determine the flux density of microwave



NIKE-ASP space probe is launched from Eglin Golf Test Range, Fla.

THE PROBLEM SOLVERS



Rockets to probe the Van Allen belt

Aerolab engineers check guidance line for the ARGO D-6 rocket that will boost a nuclear evaluation recovery vehicle (NSRV) to 1500 miles altitude to study the Van Allen radiation belt. As prime contractor to NASA, Aerolab engineers must also plot precisely the ballistic trajectory and impact point of the upgraded rocket so that the space capsule may be recovered from the ocean 1300 miles down the Pacific Missile Range.

Aerolab has developed more space probes and rocket-powered research models, including the Mercury capsule model, which have been fired,

than any other line in the United States.

Currently, Aerolab, a wholly-owned subsidiary of Ryan Aeronautical Company, is developing instrumentation packages, attitude and stability controls for payload packages, perfille collimator, payload recovery systems, antenna arrangements, and more core separation devices.

Thus, from the complete package in which Aerolab has experience for the entire program, to the provision of advanced components, the problems solved at Aerolab have contributed in acceptance beyond the usual

RYAN OFFERS CHALLENGING OPPORTUNITIES TO ENGINEERS

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they involving in the ranges of space. The impact of that space dust is so small, using small microphones placed under a thin metallic skin on the nose cone, and the impact signals are transmitted to ground receiving systems on the Echo Golf Test Range.

Nike-Ap has also been stricken on several launches to 160 mi. to probe data on the physics and composition of space in connection with national space programs. At least three of these vehicles have been launched since last November for this study.

Aerobee 110s have been sent 160 mi. up to measure high-altitude ionization and induced radioisotope phenomena at these heights. Aerobee 100s have been used in Project Taffelste, a test to determine feasibility of a positive communication system. The rockets are sent some 250 mi. up and a transmitter is turned to flash a coded message on a UHF radio to determine range capabilities at these heights. Other Aerobee 100s are used to measure cosmic rays similar to those handled by the 110s.

Cree Rockets

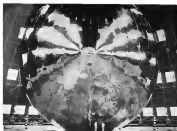
Cree rockets, which have a capability of taking an 880-lb. payload to 20 mi. heights at Mach 2 speeds, have been carrying special nose cones, escape capsule and atmospheric reentry devices to support future WAND was a space program. A series of 15 Cree rockets have been scheduled for this studies and one nose cone was successfully recovered from Gulf states 15 mi. offshore from a depth of 120 ft.

Even in the largest of the high-altitude research vehicles worked here. A 40-ft. high three ton vehicle, Egan comes a 100-lb. payload to 250 mi. altitude and reenters some 280 mi. downrange into the Gulf. This vehicle is being employed to measure cosmic ray flux density between sea level and satellite operating altitudes.

Courier BB Launch Set

Washington-Aerolab's Courier BB experimental communications satellite is scheduled to be launched Oct. 4 from Wallops Island, Virginia. The satellite is a small, lightweight, balloon-borne, and subsequent control will function in the first step of the Thor Able-Star launching vehicle.

Program management for the Able Star second step will shift from Space Technology Laboratories Inc. to Aerojet General Corp. with the launching Space Electronics Corp., as major subcontractor in Aerojet for the step, will receive detailed plans. STL continues to release engineers and technical data for the second project and has within the guidance system.



NASA Ground-Tests Inflatable Satellite

National Aeronautics and Space Administration 100-Hz inflatable satellite is subjected with 49,000 lb. of air during ground test. Echo I inflation satellite (AVC Aug. 22, p. 30) was subjected after upstart into orbit by expansion of inflated air. To be at 100 mi. and 20 ft. of inflation, both inflation pressure (100 lb. per sq. in.) of pressure are required to keep Echo I inflated during orbit. The gas is believed to be coming through punctures made by meteorites and through 242 venting holes causing swelling of the aluminum coated plastic skin (AVC Aug. 12, p. 14).

SILICONE NEWS from Dow Corning



Photo courtesy of Dow Corning

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Soviets Decline Posts in Space Academy

By Erik Clark

Stockholm—International Academy of Astronautics has begun its first year of operation with an initial membership of 43 scientists, engineers and lawyers from 18 nations but with Soviet Russia—one of the two leaders in the space field—still declining to participate.

Vacancies are being held open for new Russian scientists recruited by the founding committee in the hope that the Soviet government might approve of their participation if world tensions are eased.

Eleven U.S. scientists and engineers and two astronauts who have specialized in space law are included in the initial membership which eventually will grow to 100.

Creation of an academy to honor "individuals who have distinguished themselves in one of the fields of astronautics or one of the branches of all sciences of fundamental importance for the exploration of space" was proposed to the governing council of the 25-nation International Astronautical Federation at its 11th annual congress in London last year.

Dr. Theodor von Karman was named chairman of a founding committee and expected to choose its members. Although nationality is not supposed to be a consideration in selecting academy members, Karman has indicated that strong U.S. interest in and possible domination of the academy might be an initial reason for reducing the non-membership. Russia has openly declared itself in favor of giving stronger positions to the nations which are leading in space exploration and made this an issue at the recent 11th annual IAF congress here.

Committee Composition

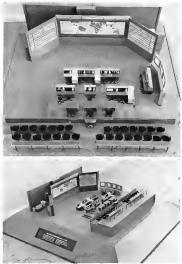
Prof. Konrad I. Soder, who was elected president of the IAF at this congress, was a member of Dr. von Karman's founding committee. He stated at his press conference during the just past week that Russia has raised the question of non-membership, making of the 25-nation founding committee its actual identity. Karman is a veteran astronaut from the U.S., including von Karman, three each from France and Germany, two each from England and Italy, and one each from Russia, Belgium, Argentina, Czechoslovakia and Switzerland.

When the academy held its first special meeting in conjunction with the IAF congress here, names of the 43 initial members were provided. This group does not include Konstantin Venetsky, Opatovskiy, Bulgakov, Solov, Novoselov, Vlasov, Kozlov or

Serdien of Russia or Prof. Brian S.W. Mason of England, who also declined a seat.

By invitation, the 43 who accepted seats broke down to—U.S. 15, France 6, Germany 5, England 4, Belgium 3, Italy 3, Czechoslovakia 2, and one each for Sweden, Bulgaria, Switzerland, Netherlands, Argentina, Yugoslavia and Canada.

Aside from national and scientific ties, there is no doubt that U.S. members have constituted the strongest single force behind the organization and its provision of the academy. Among the most instrumental was Andrew G. Haley, Washington attorney, general counsel of NASA and a former IAF president. Haley is said to have explained the aid of Dr. von Karman, who is



Model Shows Layout of Mercury Control Room

Project Mercury control room to be constructed at Cape Canaveral, Fla. It shows its scale model. Wall map, 20 ft. x 6 ft., is being built by Smithsonian Institution, Dr. Victor Gold. Map will show position of orbiting capsule, displays along top of map will indicate number of orbit and significant flight event time. Clocks lining wall will show status of primary capsule systems and conditions of pilot.

count them...



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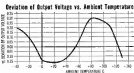
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start has arranged for a \$74,800, three-year grant from the David and Lucile Packard Foundation to permit the academy to employ a staff and begin its work.

Academy Staff

Van Kesteren has been named director of the academy, with Paul J. Price and Dr. Frank J. Milnes both of Toronto as deputies. A. R. Weller of Toronto is acting secretary. The academy will share temporary offices with the IAF at 12 Rue de Commerce in Paris. It begins its first year the academy:

- Created a Cagliostro International Astronautics Award, not to exceed \$1,000 to be awarded for outstanding contributions in the last year's work.
- Created an International Lunar Lakeview Committee to study the question of land for such a laboratory and the types of research to be done in it.
- Decided to elect new members next December to bring the academy to about two-thirds of full membership.
- Created a joint committee on space law with the International Institute of Space Law, a body which also was proposed by the IAF at the London conference. Prof. John Colin Cooper is committee chairman.
- Prepared to plan special symposia, both in conjunction with IAF congresses and separately, if desired.
- Prepared along the United Nations Economic, Social and Cultural Organization (UNESCO) for a grant in 1961, 1962, part of which would be used for a preliminary study group to determine desirability and feasibility of holding a symposium in 1967 on the problems of space in space.
- Planned to publish a journal to supplement national journals in the space field.
- Planned to take over from the IAF preparation of a handbook, in several languages of space research since IAF has asked UNESCO for financial help with this project.
- Suggested that IAF, which has cooperative arrangements with the UN, UNESCO and the International Telecommunications Union, make similar agreements with the World Meteorological Organization, World Health Organization and International Atomic Energy Agency, and proposed that the academy explore the best means for cooperating with the International Council of Scientific Unions, Council for International Organizations of the Medical Sciences and those of other national Engineering Organizations.

Academy membership is divided into three groups—basic members, affiliated members and life members (designated 45 members are:

- Basic members: Prof. H. G. Allen,

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Soviets Exhibit Payload Recovered From Sputnik V

Swart dog Belka is exhibited in a Moscow radio station after returning to earth in a capsule recovered from Sputnik V (APR. 23, p. 25). Containers at right hold rats, mice and a rooster with gleams which also were orbited in the satellite.

Soviet, Prof. P. August, France, Prof. N. August, Bulgaria, Dr. J. G. Davies, England, Prof. Alfred Elmsert, Germany, Prof. Vladimir Gorb, Czechoslovakia, Dr. Joseph Kaplan, U.S., Prof. A. C. J. Lovell, England, Prof. M. Noerdli, Belgium, Prof. J. P. P. France, Dr. Louis Senger-Bredt, Germany, Dr. Lorenz Späth, R., U.S., Prof. H. C.

U.S., Prof. J. S. Van Allen, U.S. Applied sciences, Prof. J. Aclert, Switzerland, Dr. Werner von Braun, U.S., Prof. L. Brando, Italy, Prof. E. A. Braun, France, A. V. Clement, England, Prof. G. A. Cannon, Italy, Dr. Hugh L. Davies, U.S., Prof. A. E. E. Italy, Dr. Theodor von Kormen, U.S., Prof. J. M. J. Koss, the Netherlands.

lands, Prof. L. Midwood, France, Dr. F. J. Michel, France, Dr. Hermann Oberth, Germany, Prof. K. Fied, Czechoslovakia, Dr. William H. Pickering, U.S., Dr. Eugene Singer, Germany, Dr. L. R. Shepherd, England, Prof. Wladimir M. Tolstunov, Argentina.

Life sciences, Prof. K. K. Anders, Yugoslavia, Gen. P. M. Bogdanov, France, Prof. J. C. Cooper, U.S., Dr. F. Dard, Belgium, Reg. Gen. Don Flückiger, U.S., Prof. M. Flückiger, Belgium, Prof. W. K. Frank, Canada, Andrew Haley, U.S., Dr. W. Randolph Lavinia, U.S., Prof. Alan Mars, Germany, and Dr. Herbert Strughold, U.S.

Manuscript of 165 will be divided 60 each for basic and applied sciences, 45 for life sciences.

GE Tests Spacecraft Fuselage Protection

Washington—General Electric research project indicates spacecraft built of multi-wall construction can save more than 50% in weight and provide the same protection against micrometeoroids as single solid walls.

After 143 pellets, fringing simulating micrometeorite impacts at velocities up to 12,500 mph, GE's Missile and Space Vehicle Dept. has determined that thick aluminum, steel and magnesium "bumpers" shatter, shattering, dissipating much of the pellet energy, melting in only solid getting of the vehicle's pressure hull. Pellets, made of aluminum, steel and titanium, ranged in size from one-eighth to one-half inch. Magnesium containment involves layers of solid wall separated by an insulating. Composite build program cost \$40,000.



Convair-Ft. Worth Builds Centour Nose Cones

First nose cone for Centour, built entirely of reinforced plastic material and designed to build period during ascent, has been completed by Convair-Ft. Worth and will be shipped to Convair Aerospace, San Diego, for ground tests. Later nose built at Convair-Ft. Worth will go directly to Cape Canaveral, Fla., where Minicentour landings are scheduled to begin next year. Cone is of glass fiber reinforced composite comprising a honeycomb core bonded between layers of glass-reinforced plastic. Nose cone will be painted in 1960.



Night hoisting of a meteorological rocket from the deck of the new Russian scientific research ship *Shokalskiy* is very short. At right technicians work in ship's rocket hold.



Meteorological rocket is moved to forward deck from rocket hold of *Shokalskiy*.



Weather Rockets

New Soviet meteorological rocket firing scientific research ship *Shokalskiy* has a displacement of 3,600 registry tons, a speed of 15 mph and extended range which permits the ship to remain at sea for 150 days. Rockets are stored in a hold beneath the forward deck. Instrumented nose section is attached below rocket is used to fire deck through a special hatch. According to the Soviet ship *Shokalskiy* will "systematically measure the radioactivity of the sea, group 100m and so on." The ship is scheduled to go to Vladivostok before heading out to sea for its extended voyage in the Pacific. Russia has fired research rockets from aboard ship into the Soviet Main observation in the Antarctic, or equatorial latitude and in northern parts of the Pacific. It is believed that research rockets were not moved and run up through the deck as is done on the *Shokalskiy*. The Soviet rockets are fired to study present temperatures and solar radiation effects, and especially search for altitude of 50 km.



A meteorological rocket is launched from the Soviet scientific research ship *Shokalskiy* (AW July 15, p. 20).

Launched From Soviet Scientific-Research Ship

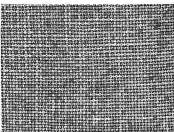


Engineer completes assembly of control unit (left) and technicians check instruments in the nose section of meteorological rocket (right).



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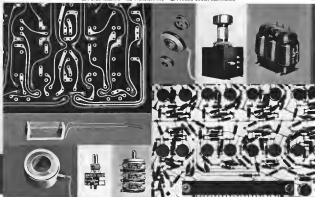
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Symposium Gages Life Support Progress

By Russell Hawkins

Los Angeles—The 15th symposium in the U.S. environment on tracking attitudes, data processing systems and launch facilities funded in fiscal 1967 for space programs was called the beginning of a new era in ground facilities by NASA Administrator F. Karl Glavin at the Fifth Defense Manoeuvres and Space Technology Symposium last week.

The three-day symposium was attended by 800 people from universities and the military services. It was sponsored by Air Force Research, Manoeuvres, Space Technology Laboratory, Los Angeles, and Aerospace Corp.

Reliability Problems

Unusual reliability problems involved cyclic redesign of systems mentioned by D. F. Mitchell of Northrop Corp. Though a culture of living organisms will not wear out like a mechanical system, it is possible for the

characteristics of the organisms to change by genetic evolution so as to upset the balance of the ecological cycle. The useful qualities of the organisms might disappear completely or the organisms might become so resistant to sterilizing vapors, food and water that human life would be impossible.

Biological cultures in tank systems can also be disturbed by poor detail engineering. Algae are poisoned by natural corrosion materials such as brass. If corrosion prevented the plating on a brass fitting in an algae tank, the culture and eventually the crew, would die.

Mitchell suggested that remote culture might be essential for investigation of the nature of the original culture and modified by exotherms or distillers in space, urban use. However, reserves might undergo the same changes in the main culture.

He said it is essential that the life support system be designed to monitor

age stability of the culture by using artificial selection of organisms with the desired characteristics and that the system be carefully chosen and if necessary modified at the laboratory to improve their value in a stable system.

Impact Shock

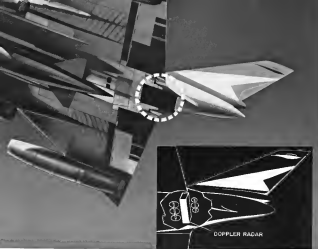
There is as yet no practical method of impact protection in aircraft being returned to earth by a parachute recovery system, according to James D. Boudier of Wright Air Development Division. Boudier was reporting the results of 58 human subject experiments conducted at the WADD in closed seat tests with impact reduction up to 30 g, acceleration up to 50 g and onset rates up to 47,500 g/sec.

Boudier said the landing impact problem with the parachute recovery technique was unsolved in each design studies probably because of comprehension produced by wind diffi-



B-52G Crew Suited for High Altitude

Six men, Boeing Wichita B-52G crewmen experienced flight crew lines up wearing MD-3 pressure suits prior to boarding the missile plane from Number 10 high altitude test flight, according to WADD. The 44,000-lb Strategic Air Command bomber has been flown to altitudes exceeding 50,000 ft. Last B-52G mission by SAC has moved off Boeing assembly line.



DOPPLER RADAR

prograde oscillations, lack of directional control and inability to change aspect rate. The effects of these aspects to have been neglected and design requirements appear to have been set by vertical descent vectors, which may be less than some of those produced by the compensating forces.

Acceleration Protection

A method of heading those multi-directional aspect velocities was called essential to development of escape and recovery systems. Since the horizon occupant is placed in a posture to give him maximum protective aspect, an oscillation in one direction, he is in a potentially dangerous position to withstand accelerations in other directions. Air bag decelerations were called inadequate because horizontal velocities of more than 25 ft/sec tend to shear the bag out from under the vehicle as to make the vehicle topple.

In the WADD experiments cited by Bratley, the paper homocentric capacitor attenuator design with different surface areas and potential crash distances were used. An undesirable characteristic of the homocentric attenuator has been a short duration initial peak in the acceleration profile. It is apparently caused by the initial force required to start the crash of the homocentric material. The magnitude of the initial peak has been cut by pre-excluding the homocentric dielectric.

The standard lap belt and shoulder harness were used in the experiments, but it was soon found that additional restraint was needed to prevent the head and legs of the human subject from rebounding and thus amplifying their acceleration responses.

Body Support

Two types of body support are being investigated in the WADD research program. One is the relatively familiar reinforced crash of rigid airframe forms which is cut from models that are individually fitted to each subject. The other is a rubber-covered vacuum of resins, hollow, non-ferroelectric spheres, made round. When hollow. At normal atmospheric pressure, the cushion is soft and may be shaped to the occupant to the desired contour but when contacted to a vacuum source it becomes rigid and the contour of the occupant is retained. The cushion may be sealed to remove air and then evacuated again to fix a new one. By this method it can be redesigned to be more comfortable during countdown, abort, etc. Until the Man-in-the-Space system was tried comfort and the safety of rigid crash housing had been considered unacceptable.

Part of the amplification program for Times II will be a search to a still

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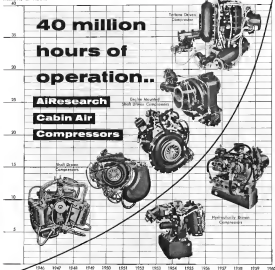
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level current electrical system and a solid hydraulic system without ground components, Bole Gledhill of Martin-Denver reported in one of the featured workshops. The changes will cut down the number of umbilical lines and ground wires.

AEC Reduces Limits On Radiation Exposure

Washington-Alabama study indicates exposure limit for atomic energy workers has been reduced two-thirds by the Atomic Energy Commission so that it is now equal to the much lower level which the National Aeronautics and Space Administration has adopted for the careers of space vehicles.

Beginning Jan. 1, the AEC exposure limits will be 5 REM (Roentgen) exposure level area, a measure of absorbed energy) per year as compared with the current exposure regulations which allow 3.3 REM per year and 15 REM per year without further restriction at a cumulative dose.

Preliminary design specifications for NASA space vehicles call for maximum radiation dosage of 3.3 REM per year, 5 REM per year and 15 REM in a lifetime. These specifications are in agreement with the recommendations of the National Committee on Radiation Protection and published by the National Bureau of Standards.

Increased concern about radiation exposure is attributed by the AEC to a desire to bring radiation standards into accord with the latest trends in scientific opinion and "to reflect awareness of the probability of a large future increase in radiation dose."

Final decisions regarding the radiation exposure limits for military or commercial astronauts are still in abeyance, however. The current limits will place almost insurmountable loads upon vehicle designers because of the great shielding weight required to bring crew members' doses to the permitted radiation level. Air Force is now using a maximum weight radiation dose of about 20 REM per year and 200 REM per lifetime in the preliminary design of manned powered aircraft. Crew flight time in these studies, however, is 1,000 hours per year and the shield is reduced to bring flight loads down to line with the new AEC regulations.

Present design limits are expected to be used in design work for some time but studies to more precisely define the biological effects of radiation are rather slow at high altitudes and in space are being pursued by the Air Force, NASA and the AEC to reconcile which divergent scientific opinions.

Fall Firing Set for Ozone-Testing Rockets

Washington-Southwestern firing of upper air ozone sampling rockets from widely separated points in the Pacific will begin this fall.

Project named Ozone, will use Aozon rockets and will have the advantage of the time of detection of ozone at altitudes up to 45 mi. in some large-scale circulation over half the earth's surface.

Launch sites will be Honolulu, Hilo and the Hawaiian island of Kauai. In addition to air circulation, the composition of the upper atmosphere will be analyzed by measuring ozone air concentration.

On reaching a height of 45 mi., the single stage solid propellant rocket and the nose cone will be separated and the instruments lowered by a 15 ft. parachute which is coated with a thin layer of silver to make solar tracking more efficient.

Micrographs will be transmitted to the ground, while radio data will record drift data.

Sponsor is the Office of Naval Research.

Project will be supported by the Pacific Missile Range.

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PROBLEMATICAL RECREATIONS 32



A rich father had 13 children by his first wife and 15 by the second. The second wife wished to secure the heritage to one of her own children and persuaded him to seal all 28 in a casket and commit all every tenth child until only 1 remained. The first 14 thus eliminated were all his first wife's children. From this point on he wanted that they come back from him from his first wife's last remaining child. Is what could seal his first wife's children? Who became him?

—Catherine Emerson

Our Western Division has placed in a horizontally sealed cylindrical case 3" high x 4" in diameter a large recorder capable of recording 14 inches and surviving 500 g impact deceleration and 1,500-g shock. It is for a surface-mount fuel nozzle.

HOWTO DO LAST WEEK'S PROBLEM: Two equations with three unknowns are not necessarily unsolvable for one of the unknowns. In this case, if it does, which turns out to be 3-7/11 hours.

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SAC FLEXES A NEW MUSCLE

Beneath the wings of its new intercontinental bomber SAC now packs a formidable new weapon—the GAM-77 HOUND DOG air-to-surface missile. The first operational unit to carry the sophisticated HOUND DOG is the 4138th Strategic Wing, based at Eglin Air Force Base, Florida.

This B-52/GAM-77 union greatly extends the useful life and striking power of SAC's long range bombers and adds to the command's operational flexibility. The HOUND DOG's versatile capabilities have been

demonstrated in a number of free flights over the Atlantic Missile Range and the Eglin Gulf Test Range. In addition, it has withstood many extreme environmental tests including a 10,000 mile flight over the North Pole ending with a successful firing over AZIR.

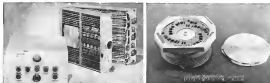
In just 34 months, the HOUND DOG air-to-surface missile progressed from the drawing board to its first flights with SAC crews. Combined with the B-52 bomber, the HOUND DOG gives SAC a powerful new deterrent for preserving world peace.

THE MISSILE DIVISION OF NORTH AMERICAN AVIATION, INC.



Division of Ford Corp.

AVIONICS



AVIONICS DIGITAL COMPUTER for Hound Dog inertial guidance system (left), produced by Autonetics, is opening door at base in 1,000 lb. hefters helmet. Computer contains 16,500 components, equivalent of 34 TV receivers. Magnetic disk assembly is shown at right.

Digital Computer Reliability Grows

By Philip J. Klein

Washington—Autonetics digital computers now are selecting inhibitors which switch or control those of less complex avionics components, a technique which seemed unlikely when digital computers were first proposed for reference one less than a decade ago (AV Dec. 29, 1955, p. 27).

At that time, large ground-based computers seldom operated for more than a few hours before malfunctioning. The prospect of operating down the size and weight of such computers by a factor of 100:1, and simultaneously increasing their reliability by at least an order of magnitude appeared due to time, observation.

Today, however, these are at least a dozen avionics computers that have done just that and still are climbing into airframes digital computers are and weight while pushing up reliability.

Hound Dog System

One example reported at the recent Six Days meeting of the American Institute of Electrical Engineers is the digital computer for the inertial guidance system used on the Hound Dog air-to-surface missile, produced by North American's Autonetics Division.

The computer contains approximately 16,500 components, roughly the equivalent of 34 home television receivers in terms of number of components, according to Joseph T. Charnay, Autonetics project engineer. But the computer occupies only 14 lb. and, smaller than one home TV receiver.

Some of these Hound Dog computers have exhibited an on-airframe operational life (MTBF) of close to 1,000 hr. That is roughly the equivalent of a home TV

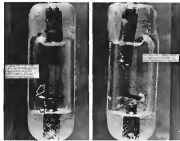
receiving operating for 5 hr every day for 25 years without a single malfunction.

Autonetics' version of Hound Dog computers that come off its line during early production and went into service use show an average MTBF of about 70 hr. Improved quality components introduced early this year are expected to double this MTBF figure for computers now rolling off the line, Charnay indicated.

The Hound Dog computer is actually two computers in a single package

One is a digital differential analyzer, which performs real-time computations required for missile guidance. The other is a general-purpose machine which performs independent required computations, multiplies periodic self-tests of level all computer operations and performs diagnostic functions when malfunctions occur.

Computer also contains an input-output section for analog-to-digital and digital-to-analog conversion. Machine is designed to accept 16 independent inputs through of five different types and



MICROSCOPIC examination of each diode can disclose mechanical details which do not show up in diode functional tests but which can cause failure in subsequent service. Two typical details are shown above.

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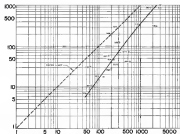
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MEAN-TIME-BETWEEN-FAILURE of each Thermal Dig computer shows wide variation, with some evidence of "actual mortality" dips follows in such case. Numbers designate each dot show actual number of the computer. Current units are expected to show higher reliability.

15 independent outputs of different types, classes required.

Computer is contained in a single assembly, measuring 15 1/2 x 20 x 5 in. It requires a total of 91 plug-in modules, measuring 5 x 5 in., each receiving an average of 180 components on both sides of an etched circuit board. A rotating magnetic disk serves as the storage device.

During development each module is subjected to extensive functional testing using automatic test equipment.

The completely assembled computer must then operate for five hours, continuously performing computations before it is released to be incorporated in the guidance system. After again the computer is tested as a part of the overall guidance system tests.

Improving Reliability

Because defects make up roughly half of the total components used in the computer and transistor contribute roughly 10%, Autonetics turned its attention to these two areas which it sought to improve original computer reliability. Although Autonetics originally selected some miniature parts to reduce MIL specifications whenever possible, it nevertheless found it necessary to conduct extensive test and inspection of receiving devices to meet its own reliability requirements.

Autonetics, one of the first companies to use X-ray and microscopic inspection of circuit traces some years ago for its Navaho missile program, also instituted microscopic inspection of its glass-coated relayed devices. It found a number of mechanical defects in double fabrication not detected by the semiconductor

test's plant. Autonetics fed back this data to manufacturers under extreme environmental conditions to go through the test could pass functional inspection in practice tests.

Recognizing that such inspection might be helpful to the double manufacturers plant, Autonetics fed back its findings to its suppliers and has since gotten them to institute microscopic inspection and other controls intended to improve semiconductor device quality, Clonon told Avionics News.

The introduction of added quality control of the component manufacturers plant can be quite costly in terms of individual component cost. But the more costly components increase the overall computer cost only slightly and greatly improve its reliability. Autonetics manufacturers showed. For example, although Autonetics now is paying approximately three times as much for its diodes as it formerly paid and consequently must bear the increased cost and inspection time, its plan quality components increase overall computer cost by only 1%, according to Clonon. But they are expected to wear down due to wear-out between 100,000 to 1,000,000 hours.

One Thermal Dig computer, selected at random from the production line, was more than a year ago, has been placed in the laboratory for a total of 7,440 hours on average MTRF of 420 hr. If it was not for these malfunctions that resulted from random wear-out in the type of the computer the average MTRF would have been more than 1,000 hr.

During the test 735 hr. of the test computer was coded as on and off each



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1,000 times at 15-msec intervals without any component malfunctions according to Chester.

Records of failures occurring in early production computers after they had been tested with the rest of the guidance system and subjected to oval critical tests show a considerable spread of MTBF figures, ranging from a low of 7 hr. to as high as 1,000 hr., with a median value of about 70 hr.

Analysis of the results of these tests suggest that digital computers now experience a form of "natural mortality" similar to that of vacuum tubes and other components when failure rate is highest in the first few hours.

Data indicates that computers that had operated for the longest total time, had the lowest failure rates, whereas those that had been operated for only short periods of time had comparatively high failure rates. If subsequent data confirms the existence of this natural mortality, it would be logical to operate all computers in the factory for sufficient periods to cover their peak high failure rate interval.

Puerto Rico Radar To Probe Ionosphere

Washington-Radar with a 1,000 ft. diameter antenna, termed the world's largest, will be built in Puerto Rico to support the study of the newly established Defense Department Ionosphere Research Facility.

Site of the antenna, which will be in the face of a local or segment of a sphere, will be in a natural valley formed by an ancient mountain peak 15 mi. south of Arecibo, which is on the north coast of Puerto Rico, and 23 mi. east of Bayamón, A.R.

Initial studies will be made of the nature and characteristics of the earth's ionosphere, roughly between 40 and 600 mi. above the earth's surface. The antenna will not only be able to act as a radio telescope of great sensitivity, but will be able to transmit probes which will be reflected from the ionosphere, the moon, the planets of the solar system and other objects in space.

Financing and funding of the \$5.5 million project is under the Advanced Research Projects Agency, with technical support and management by the Research Division of the Air Research and Development Command. Prime contractor is General Dynamics, which conceived the idea.

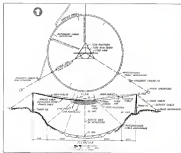
Although the segment of a sphere could be moved at one point in space of a fixed focal and reception system was installed, the antenna capability will cover a cone of 40 deg. by moving the focal point.

Power of the radar will be generated

from an compressible gas turbine system now in constant enabling combat with the planets.

One possible accomplishment will be locating the rotational rate of the planet Venus whose dense clouds have defied

scientific surface analysis in the past. It also will be useful in detecting signals from stars and planets, solar disturbances and the source of new thermal radiation from the planet Jupiter.



WORLD'S LARGEST solar telescope, with antenna dish diameter of 1,000 ft., capable of detecting a 5-ft.-square object 22,000 mi. away is being constructed in a natural limestone bowl in Puerto Rico. It is expected to be in operation in July, 1965. Operating at the frequency of 400 mc. with peak power of 21 megawatts, solar will be used to study surface of the sun, sun, Venus and Mars and to measure the rotation, size and distance of solar system planets and probe the atmosphere of Mercury and Jupiter. Radar will also be used to measure earth's ionosphere electron density, topography and antenna and nearby magnetic field. Radar also can be used as a radio telescope. Antenna receiving will be room-placed by local antennas, suspended over fixed antenna dish which can rotate through 144 deg. to transmit and receive 30-deg. off vertical. Radar is being built under sponsor ship of Advanced Research Projects Agency with Air Force Research Division as responsible agency.



FORD INSTRUMENT CO. data bulletin

NO. 2 OF A SERIES OF ADVERTISEMENTS

LONG ISLAND CITY 3, N. Y.

New Digital "Platform Computers" Advance to Hardware Stage

Started to Replace Bulky "Stable Elements" in Aero-Nuc Systems

Two new special-purpose digital computers, now being designed and built by Ford Instrument Co. as part of the AN/ALN-1 "strapped-down" aerial navigation system, moved recently from the theoretical to the hardware stage with construction of the first equipment models.

Developed by Ford Instrument, under U. S. Air Force contract, for the Weapons Guidance Laboratory of Wright Air Development Command, the new "Fordac" computer is the heart of an advanced aerial navigation system that does away with the "stable platform" of conventional aerial navigation systems. The new system is called a "strapped-down" aerial system (or sometimes a "platformless" or "inertial") system because the previous components are largely removed. The most distinctive of a stable platform are performed by the computer automatically.

In its final configuration, "Fordac" will

be a compact, lightweight, all-solid-state computer especially suited for airborne packaging. It employs novel techniques to compute and maintain the new derivation system that relate the coordinate system defining the vehicle axis to a space-fixed frame of reference. The name "Fordac" is derived from the words "Ford-Aero-Compu-Nav".

In conventional aerial navigation systems, the moving guided structure requires a great deal of unsketched space. Usually, space requirements increase with increasing requirements for more guided structure, since they are built to extremely close tolerances. All of these problems are bypassed in the AN/ALN-1 system.

The second computer, which was developed by Ford Instrument under a supplement to the original AN/ALN-1 contract, is a new solid state digital computer that combines conventional and DDA (Digital

Developments at Ford Instrument Co., Division of Sperry Rand Corporation, that are of particular interest to users of special-purpose computers and controls.



Ford Instrument Co. replaces bulky old "stable platform" modules for jet-propelled "Fordac" digital computer.

Differential Amplifier techniques. The unit will be built in a "Fordac" from "Fordac" computer. It will contain the output of "Fordac" with information from vehicle sensors to compute the position of the vehicle with respect to the earth.

New Fallout Predictor to Aid National Defense



New Ford Instrument fallout predictor can automatically generate data in form of contour maps, such as shown at right. Charted lines indicate points of equal radiation dosage.

A new computer to predict nuclear fallout patterns— from complex, variable weapon, topographical and meteorological data is being developed at Ford Instrument under U. S. Army Signal Corps contract from Ft. Monmouth, N. J.

The computer automatically delivers an output for instantaneous decisions, and will cover an area up to 5,000 square miles.

The contract for the new computer extends the processing work previously done by Ford Instrument as the subject of determining radiation effects. The work encompasses all of the problem areas from

character of weapons through aerial dynamics.

The new fallout predictor will reduce the numerous parameters and their relationship to uncorrelated fallout distribution with regard to time and space under varying meteorological conditions. Fallout predictions are considered from the viewpoint of having a maximum amount of accurate legible data available.

The new fallout predictor represents just one example of Ford Instrument's special-purpose computer capabilities, which are aimed to every phase of computer development, from design to quantity production.



Left: Ford Instrument technicians operate and test analog platform for Army JUPITER missile as part of Ford Instrument's extensive "clean room" facilities.

Right: U. S. Army JANG II, carrying the JUPITER W space probe and many Ford Instrument gas and control components, is launched today by National Aeronautics & Space Administration.

Eleven Years of Missile Guidance

1960 marks the 11th year since Ford Instrument first received the contract for missile guidance as control. These first contracts were for the prototypes of the launching and control order computers for the still experimental U. S. Navy THUNDER missile.

With these contracts Ford Instrument began to apply its experience to the requirements posed in 24 years of continuous missile guidance systems work. And, since those contracts, Ford Instrument has accumulated an impressive array of experience as a designer and manufacturer of guidance systems, subroutines, and components for the state-of-the-art missile and its associated guidance systems.

Available among these are: The complete guidance and control systems for the Army JUPITER and JUPITER missiles, many sub-guidance and control components for the guidance launching JUPITER, control computers for the "missile space" vehicle structure, launching and control order computers for the Navy's THUNDER missile (in addition to those for the THUNDER missile shown above), Air Force missile projects including the "stepped down" or "glider-based" inertial system described in earlier work on these pages—plus a wide variety of ground support and production test equipment for missiles.

Remington Rand to Use New Reversible Data Converter

Remington Rand Company, Division of Sperry Rand, has ordered a new version of Ford Instrument's newly designed, all-solid-state, reversible analog-to-digital converter for use in future U.S. shipboard systems. The use of such converters makes possible the application of the latest digital techniques on ships using analog sensing devices as required.

Considered the most versatile data converter available, this equipment was originally developed by Ford Instrument under contract with the U. S. Navy Bureau of Ships. The first and recently completed successful evaluation tests at the Naval Electronics Laboratory, San Diego, Calif.

Referred to as a "reversible universal analog data converter" this device can be made to accommodate either analog-to-digital or digital-to-analog flow of information for all types of voltages. Although developed for a specific purpose, modifications can readily adapt it to the user with almost any digital computer. The fact that it can transmit digital output information into analog form—as well as the reverse—makes the new converter ideal for sensing analog-type stress and control systems for applications such as control flight-control, guidance and guidance and inertial control systems.

Significant converters have been required in the past for each type of analog input voltage delivered by the various types of sensors. Now, for the first time, a single solid-state converter is capable of handling widely different types of voltage inputs. In the new converter, analog inputs in the form of ± 1 voltages, dc voltages, and synchro signals can be converted at the rate of 4000 samples per second. Studies indicate that the equipment can be prolonged even less than standard cable but making it ideal for guidance and missile applications.

The new digital converter is the outgrowth of an years of development such as this field. It was designed and fabricated in industry requirements and specifications.

New Precision Computer Components

A new 1/32 inch ball core integrator and a new 1/32 inch standard differential are among the latest units added to the Ford Instrument line of solid-state precision mechanical and electro-mechanical computer components.

The new 1/32 inch integrator achieves the same accuracy as previous components with three times as large and represents a major "breakthrough" in the design of mechanical integrators.

The 1/32 inch differential is the smallest of Ford Instrument's single-order precision units. It also provides extreme accuracy in addition and subtraction operations with minimum friction and backlash.

Product data sheets on these units—as well as on Ford Instrument's "Tolpex" synchro and other electro-mechanical components—are available for free索取. Write Components Division at address on back page.



New 1/32" integrator.



New 1/32" differential

Aerial Recon Data Integrated



One possible method of combined sensor display presentation. This would be suitable to test in order to flight data instead of allowing to test for analysis of data.

Study Seeks Optimum Display Methods for Radar, Infrared, and Photo Data

There's one brief description of the type of combined sensor display information our customers' pilots may be looking at shortly in the future.

It represents a possible result of a new all-weather, multi-sensor display study being undertaken at Ford Instrument under an Air Force contract from Wright Air Development Division.

The project will develop optimum methods for selecting interpretation of information received from the most commonly used types of reconnaissance sensors—photo-graphic, radar, and infrared—simultaneously after exposure.

Timing, size, illumination level, display rates, and many other parameters of reconnaissance viewing are being considered, and particular emphasis is being placed upon the verification of information from more than one sensor type.

The new study contains one of the largest and most refined by Ford Instrument in this field, outside the pioneering work of the company on the subject of Integrated Sensor Interpretation Techniques. A wide array of specialists, including large enterprises, known engineering specialists and engineers, are applying their special skills to these problems.

Radio, infrared and aerial photographs, when used independently, each have ad-

vantages and limitations, but, in combination, they make possible more effective and reliable in-flight target detection.

Radar, operating at any time of day or night and in all but the worst weather, is especially useful for detecting weather objects and structures.

Infrared images are clear when there are temperature differences between the objects or features recorded. Therefore targets which are warmer than their surroundings are detectable by infrared even when they are not visible on the aerial photographs.

Since both radar and infrared provide desirable properties which both resolution aerial cameras do not have, it is possible to make use of a combination of these sensors for more reliable in-flight target detection. The present work is primarily devoted toward certain military systems, but it is possible to extend it toward other types of strategic systems.



Simulated presentation of Ford Instrument's line study of combined sensor displays by psychologists and human engineers as well as equipment engineers.

Recon Drone Unit Delivered

The prototype model of the AN/USP-1 drone control, built by Ford Instrument for the U. S. Army Signal Corps, was shipped to Fort Huchison, Ariz., recently for a rigorous series of field tests.



The system, shown here during field New York checkout before shipment, comprises an optical position and direction unit, a portable control unit (in foreground), and a motor mounting a map plotting board, computer and radar. Designed for battlefield use, the equipment can be set up, camouflaged and put into operation by two men in an extremely short period of time.

Engineers, Scientists Needed

New projects at Ford Instrument have created outstanding employment opportunities for experienced systems engineers and scientists for work in digital computer engineering and programming, advanced mathematics, thermionic experimental solid-state physics and microwave devices. Additional openings in R. L. Blackburn. They will be held in strict confidence.

Computer Navigation Scores Again

The U. S. Air Force has recently awarded Ford Instrument Company an additional \$6 million, apparently in connection with AN/ASN-7 navigation systems, computer, and test equipment.

During the previous nine months, U. S. Air Force contracts for this equipment have totaled approximately \$21 million. The



AN/ASN-7 is a dual-earthing system and device computer system being used in KC-135s, F-105-F's and other aircraft to provide extremely accurate navigation.

Thermionic-Cell Temperatures Lowered

Ford Instrument research in thermionic has lowered operating temperatures for experimental mercury-vacuum cells to about 2,000°F., as against 4,000°F. previously required, for substantial current densities.

This is one of the latest results of Ford Instrument studies in thermionic—the direct conversion of heat to electricity. A

power supply, the new thermionic cells are expected to have the advantages of light weight, compactness, complete lack of moving parts, complete silence—important for military use—and the possibility of utilizing the heat (as well as the electric) output of the cell.

Additional Ford Instrument activities in the new field of thermionic include construction of experimental thermionic cells, investigation of the feasibility of building thermionic converters into the fuel elements of nuclear reactors, the use of fuel fluids and solar energy for thermionic conversion, and studies of numerous possible applications of thermionic power.

Thermionic power sources are expected to have wide potentialities in a variety of practical applications, such as supplying power for man-made, natural equipment, space satellites or vehicles, or any equipment where light weight and compactness are essential.



Ford Instrument engineer applies heat from torch to experimental thermionic cell.

We invite you to learn more . . .

Responsible agencies or industries possessing the requisite security clearance, and need to know, are invited to learn more about Ford Instrument capabilities. Ford

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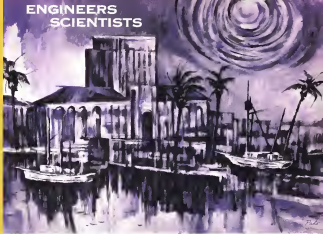
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San Diego Civic Center, an original painting by Jimmy Paine, Convair/San Diego artist.

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Specialists for the analysis and development of automatic controls.

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For analysis of problems associated with supersonic gas dynamics (free molecular and continuum flow), ablative heat transfer and hypersonic boundary layer injection processes. Advanced degree and three to five years of experience preferred.

FLUID MECHANICS

For statistical mechanics and information theory. A PhD, or equivalent is required.

AERODYNAMICS

For aerodynamic design problems of subsonic and supersonic jet transports, advanced space vehicle programs, VTOL and STOL aircraft, and advanced missile systems.

PHYSICS

A number of select positions, encompassing a broad spectrum of activity in the physical sciences, are available for PhD physicists. Current experimental and theoretical studies involve plasma, solid state, molecular, nuclear, and optical physics. Experimental physicists are also required for work in light wave reflectivity, observing experimental phenomena. Work includes some build-up and modification of laboratory equipment, including microtransducers.

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Experienced in fractional distillation of oxygen/nitrogen and ortho-para conversion of hydrogen. MS in chemical or mechanical engineering preferred.

SYSTEMS ANALYSIS

Analytical and computer planning of operation of commercial and military systems. Involves preliminary system design through economic effectiveness studies.

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Reliability engineers with statistical background for system analysis. Experience in aircraft or missile systems reliability required.

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For statistical work on electronic detection and discrimination techniques. A PhD is required.

INFRA-RED

Specialists with experimental background and experience in IR detection devices for IR reconnaissance, spectral analysis, and radiation studies.

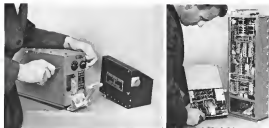
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CONVAIR/SAN DIEGO CONVAIR DIVISION OF GENERAL DYNAMICS

SD 68-001-0000



CONTROL AIR DATA computer system developed by Electronic Equipment Div. of Litton Industries in Beverly Hills, Calif., employs specially designed subminiature strain gage transducers for pressure stability and repeatability. Computer shell weighs 22.7 lb., measures 7.6 in. by 10 in., while recently located transducer-pressure package (to right of computer) weighs 1.1 lb., takes up 100 cc. in. All right package are mounted from both packages, resulting from a gross reduction in size and component count.

Litton Develops Fighter Air Data Systems

By Barry Miller

Beverly Hills, Calif.—Lightweight control air data computer system capable of providing navigation and engine fire and flight control information for responsive fighter jets. Flight profiles from sea level to 50,000 ft. and flow speeds of Mach 0.2 to 2.5 are being developed here at Litton Industries Inc.

According to the company, various aerodynamic loads by its Electronic Equipment Division now are undergoing evaluation. Quantities of these air data systems research was ordered for an advanced responsive fighter program. The air data systems can provide inputs for such functions as:

- Time elapsed sensor to within 10 ft.
- Altitude within 25-ft. at 50,000 ft.
- Mach number within 0.1 at 50,000 ft.
- Angle of attack within 0.5 deg.
- Dynamic pressure within 0.0035.
- Differential pressure within 0.16 in. of vacuum.
- Total pressure within 0.002 in. of vacuum.

Pressure Transducers

The review employs specially developed subminiature strain gage pressure transducers which experience little or no temperature impact, provide high accuracy, occupy little space and add negligible weight. These transducers were developed and are supplied by

Sturtevant Instruments, Inc., of Los Angeles and are largely responsible for the principal advantages of the system, cited by Litton.

- **Redundancy** response of the transducer to dynamic pressure changes.
- **Location** of seals, lightweight, pressure transducer 1.1 in. long 1 in. diam. size, 1 cc. weight (four sensing ports in one of two versions of the model, this eliminating pressure line delays).
- **Linearity** of the transducer to aircraft conditions, temperature, sensitive less vibration or shock.
- **Accuracy** on the order of 0.1% full scale of the transducer and associated measuring equipment into pressure values as high as 345 to 1 (116,000 lb. to sq. in.).

System Packaging

Prime system can be packaged in a single instrument unit which weighs about 22 lb. or in two separate pressure computers and a recently located transducer-pressure package which weighs 21.2 and 8.1 lb. respectively. The basic pressure package weighs about 190 grams; the computer about 715 grams.

The strain gage pressure transducer which has no moving parts was designed specifically for the Litton computer air data system although commercial versions are not now available according to a spokesman for Sturtevant. Qualification tests on the transducers show their ability to withstand 7% shock with

only 0.072% change in output and 7% accelerations, Litton says.

A self-contained pressure-to-analog converter, the strain gage does not need complex associated equipment, Litton points out and thus enhances reliability, shrinks size and weight of the sensor package and allows freedom in mechanical layout. Its sealed case permits shock thermal stabilization provided by transducer temperature control and once stabilized Litton adds the transducer is insensitive to dynamic or steady-state environmental temperature changes.

Gage Performance

The gage is a continuous structure with elements in the form of a bridge across the structure of which strain values under mechanical stress to produce variations in output voltage. This transducer senses static and total pressure and converts them into voltage signals. With gage operation is continuous and output resolution affects all values, overall resolution is fixed by the elements in the output. Individual units have low hysteresis—about 0.05% to most cases—and low linearity error over extreme pressure variations.

Litton extends the pressure transducer, allowing it can handle accuracy and stability after electronic pressure cycling in the most difficult climate in the computer.

Mechanically, the computer is designed for simplicity and ease of maintenance.

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Electro-Collimator

Electrocollimator, built by Polaris-Electro Day, consists of modified optical devices for precise unaided electronic aiming and control signals back into transmitters that support sights.

range. Core trans collimators including directly assembled, goni, and some others are designed for easy replacement and service, according to Litton Quick release type, change some electronic mechanical components to mounting surfaces and some amplifiers and some supply components are mounted as plug-in carrier cards. The transducer assembly is contained in a separate module for removal without disturbing other components.

Output Functions

Output functions proportional to altitude, density, total pressure, true airspeed, Mach number and differential pressure are derived in the system from analog computations on static pressure, total pressure and total temperature. True angle of attack is derived from sometimes as a function of Mach number in a true angle of attack sense and the output from an angle of attack sense.

Designed into the system is a timing circuit for checking the entire system, including transducers on a 100 msec level for low-flight conditions. Depressure of a button on the front panel of the air data computer causes inhibition in both the static and differential pressure transducer bridge circuit and inhibits a known resistance for the transducer probe resistance element. All sensor and output function shifts are then activated.

An output potentiometer on each shaft can be selected to a video indicator for visual observation of sensor activities. An analog indicator test a pressure test relay receives pressure and temperature probe transducer from respective sensor channels. Probe voltage corresponding to the selected flight con-

ACCURACY...

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In laboratory testing an electronic ac power source had an enormous number of applications... but whenever the voltage delivered no longer gave good the regulation and how far the deviation might be accuracy in many cases is the all-important key. Behlman's INVERTRON® provide frequency standards up to 0.00001%.



A wide variety of single, two and three phase models are available providing from 10-500-000 v ac and output frequencies fixed or variable up to 100 KC.

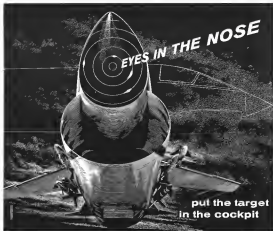
Total harmonic distortion is only 1%, max (lower on special order) voltage regulation is 1% or less to full load steered (to 0.1% on special order) The rest of the test is INVERTRON.

BEHLMAN
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As a result of development by the Magnavox Company in conjunction with the Navy Department, every Chance Vought F8U-2N Crusader Fighter Pilot sees the target at a glance—day or night, in any kind of weather.

Here are the eyes of a modern weapon system—a component that delivers the range, weight and reliability so absolutely necessary to successful tactical operations.

This airborne radar system is just one of many systems which have been and are being designed and produced to satisfy the tactical requirements of the military services in the fields of Communications, Airborne Radar, ARW, Navigation, Fighting and Data Handling.

Magnavox



AIRBORNE FIRE CONTROL RADAR

				
COMMUNICATIONS	RADAR	DATA HANDLING	ARW	MISSILES

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ditions, the company explains, are those introduced in place of transistor inputs. Selected output functions are available at a top connector and can be monitored by an external checking device.

Development of the control or data computer is the replacement of three runs of work for the electronic system division, which was assigned to letters from General Controls in December of last year.

100% FILTER CENTER CLASS

West Coast State Green-Electronics companies in the nation's 11 western states are expected to produce 25% of nation's total output, compared to last year's 20%, according to Western Electronic Manufacturers Association (WEMA). Approximately half of the projected \$2.7 billion in sales by next year alone will come from companies in the Los Angeles and adjoining Orange County area, but sales by firms in the San Francisco Bay area are growing at a slightly faster rate, WEMA says.

Speedy Digital Computer—Inhouse digital computer, capable of performing 166,000 mathematical operations per second is called "Inhouse" system computer available by Westinghouse Electric Air Division which developed



Thermionic Converter

Thermionic converter, available in pilot production quantities in Oxides from General Electric, is developed type with output of about one watt when operated at cathode temperature of 1,100°C. Device has maximum power density of 0.2 watt/sq. cm and thermal efficiency of 15%. GE hopes to add new vapor thermionic converter, using osmium vapor, to its line soon. Company reports vapor converters with outputs of 2 watts/sq. cm and efficiency of up to 15% at operating temperatures of 1,300°C. Converter is produced by GE's Power Tube Department, Waterbury, N. Y.



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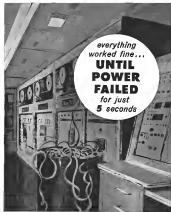
Harry E. Rothwell is Vice President of Engineering for Delavan. He is responsible for the engineering policies and organization which have successfully introduced some of the aircraft industries most challenging fuel system requirements. Mr. Rothwell has 14 years experience in this field—experience which has given him a research, design and development facility uniquely suited to solve fuel injection problems for the aircraft of today and tomorrow.

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for just
5 seconds

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If just doesn't make sense to have investments totaling millions of dollars hanging by a thread as thin as the risk of power failure.

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Strain Gage Transducer

Semiconductive strain gage transducers available in pressure range of 0-100 psi to 0-10,000 psi. All units include built-in semiconductor strain gage, push-off and a built-in transducer amplifier input and output is from 10 to 25 mV, with output of full scale equal to semiconductor input voltage. Input impedance is 700 ohms, output impedance is less than 4,500 ohms. Transducer, designated the SSG-1, is 10 x 10 x 0.010 in. long and weighs 1.5 grams. It is quoted at \$100 and available in quantities of 100 or more. Manufacturer: Fairchild Controls Corp., 221 Park Ave., Hicksville, L.I., N.Y.

the machine. Computer occupies 60 in. It and a fully transduced with alarm devices. Mayweather says are used for storage with capacity for 30,000 bits. Computer has completed 300 hours of testing, company reports.

► New Microcircuit for the General-Air bond circuitry using polyimide film hybrid circuit which exhibits a surface loss of less than 0.2 db. has been developed by Sperry Microcircuit Electronics Co. under Rome Air Development Center sponsorship. Company reports that circuit exhibits direct loss analysis of deterioration at peak power levels greater than 40 watts and average power levels of 10 kw. Sperry has designed power systems for application at GHP frequencies which can handle peak power dissipation of up to two megawatts, company reports.

► Gearing Oscillator From Vigen-Refractor oscillator consisting of a stack of nine layers of varying thickness and type of glass as a single electronic result was given by rapid phase dispersion at March, Sharp and Delaney in Rahway, N.J. The oscillator is composed of a paper switch, backscattered elastic and photo detectors all deposited and arranged individually. Laser guided rate in the paper phase process in 370 degrees per sec., reactance can be



Sensitive Strain Gage

Resistive semiconductor strain gage which employs silicon diodes that give gage factor of 100, providing 10:1 over the resistance of conventional strain gage, are available in production quantities. The Model SAS 101-100 Micro-Sensor can report at stress of more than 3,000 micro-inches per inch. Resistor has resistance of 350 ohms, operates over temperature range of -60F to 160F. Manufacturer: Vicon-Sensor, Inc., 2121 East Franklin Blvd., Pasadena, Calif., subsidiary of Electro-Optical Systems, Inc., which developed device. (AVR Feb. 1, p. 74.)

► Western Electric Co. has a 51 and 100 Advanced Branch Projects Agency contract for submarine cable systems linking Kingston and Raritan in the Marshall Islands. The last contract to be awarded for Project Press II involves detection and identification of hostile vessels worldwide.



Ryon Doppler Navigators for Navy F3V-1

Naval AFM-12 Doppler navigators are to be installed in the Navy's Lockheed P3V-1 surveillance vehicles carried by Ryan Electronics Division of Raytheon Aircraft Co., San Diego, Calif. Precision gyroscopes (dows) are part of system which has the Ryan navigators with inertial guidance system built by Latham Electronics Equipment Div. of Beverly Hills, Calif.

► Insulated Sensing System—Los Angeles is trying to interest military agencies in its high insulation, all-substrate film (14 in. 1 micron) sensing system. System employs liquid nitrogen cooled infrared microbeam detector. Power is 400 watts dissipated at 20 in. field of view x 40 x 10. Employment of recent Western film, artists had fine display but smaller film display could be substituted for military applications.

► Reliable Computer from Uniflexible Corporation—Flexibility of building reliable computers from large complexes of essentially available components in parallel reach at the base functions results with its large redundant system of available components in long studied by Eugene Prange of the Air Force Cambridge Research Laboratories and a group at Massachusetts Institute of Technology. Prange is directing his efforts at substituting a set of accurate performing and function for a single fused neuron comprising the same function.

► Western Electric Co. has a 51 and 100 Advanced Branch Projects Agency contract for submarine cable systems linking Kingston and Raritan in the Marshall Islands. The last contract to be awarded for Project Press II involves detection and identification of hostile vessels worldwide.

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Products for Aircraft and Missiles...

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Transistorized Power Supply



ready in production of Consolidated Aircraft.

Uninterrupted Power Supply



operation power without interruption. When power source fails, UPS assumes duty. When power fails, unit switches to battery power. Unit is 1.5 in. thick, 10 in. wide, 10 in. high, 10 in. deep. Unit is 1.5 in. thick, 10 in. wide, 10 in. high, 10 in. deep. Unit is 1.5 in. thick, 10 in. wide, 10 in. high, 10 in. deep. Unit is 1.5 in. thick, 10 in. wide, 10 in. high, 10 in. deep.



"Consolidated Diesel Electric Corporation" is a member of the Condec Group. The Condec Group is a leading manufacturer of power equipment for aircraft and missiles. The Condec Group is a leading manufacturer of power equipment for aircraft and missiles. The Condec Group is a leading manufacturer of power equipment for aircraft and missiles.

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A NEW TEAM with wide-ranging capabilities in the ground support field can help you with the necessary equipment for your most advanced and sophisticated systems.

Solar's divisions include weapons-system engineering and development and fabrication of different metal structures for specialized applications. In addition, Solar builds a complete line of gas turbine engines and turbochargers adapted to ground support. Through a subsidiary company, Solar also is equipped to design and build specialized electronics systems and components.

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NEW AVIONIC PRODUCTS

• **Fixed control alternator, Series 150**, available with attachments of 3, 6, and 15 dc, or the 1 to 12.4 kHz frequency range, or 20 db in range of 2 to 12.4 kHz. Temperature coefficient is 0.0001.



/46-Avg. F. Attachment measures 71 in. long and has 49 ohm impedance. Manufacturer: FKA, Inc., 1525 93rd Street, Woodside 77, N. Y.

• **Mixture magnetic clutch, Model 162**, high efficiency type with automatic torque rating of 80 in.-in. at speeds up to 3,000 rpm; is available for best operating voltages of 8, 12, 25 and 60 v. The clutch occupies about 1 cu. in., consumes 25 watts power. Unit operates up to temperature of 55°C. Manufacturer: Ultracut, Inc., 111 East 20th Ave., San Mateo, Calif.

• **Mixture metal isolator, requiring no external permanent magnets, are available for operation from 100 to X-band frequencies.** Three basic units, designed for use at "C," "S" and "L" bands (Models D44C7, D46S7 and D44L7) operate over 19% bandwidths.



provide more than 15 db isolation and less than 0.8 db insertion loss according to manufacturer. The isolators measure only 1 in. in diameter with lengths ranging from 4 in. for C-band to 61 in. for L-band, and weights ranging from 4 to 6 oz. Manufacturer: Sperry Microwave Electronics Co., Glenview, Ill.

• **Mixture electronic bandpass filters, called Minifilters, are designed for true color applications and printed circuit board mounting.** Type MNF are down less than 3 db at frequency 71/8 of

center frequency, while Type MW are down less than 3 db at frequency 15/8 of center frequency. Attenuation greater than 40 db is provided in the stop bands. Filters are available in 18 different center frequencies, from 0.4 kc to 70 kc, with complete act angle ranging from 14 in. and accepting only 70 to 80 m. Manufacturer: United Transducer Corp., 150 Vanda St., New York 15, N. Y.

• **Chopper amplifier, Model 181-0000**, for converting bandpass d.c. signal to higher points 400 cps signal, is linear for input of 0-1 v d.c. but can be operated up to 50 v d.c. Output voltage is 500 mV rms into a 10,000 ohm load. Unit consumes approximately 14 x 11 x 4 in. and weighs 6 oz. Operating temperature range is -55°C to 71°C. Manufacturer: M. Tim Bosch, Inc., 50 Wheeler Ave., Plainville, Conn. 06061.



• **Magnetic tape recorder, with its quartz acoustic from 10 to 700,000 cps at tape speed of 60 in./sec., employs all solid-state controls.** New 16 recorder independent is available in solid state or conventional type models with local spacing and track width conforming to IRIG standards in 1, 4, 7 and 14 track configurations. Specifications on available tape recorder: Precision Instrument Co., San Carlos, Calif.

• **Mixture high-power transducer, capable of sustaining pressure up to 15,000 psi, weighs less than 0.35 lb. and measures only 1 in. in diameter.** An approximately 10 in. long, New Series 1644 transducers are available to measure pressure ranges from 0-400 to 0-15,000 psi, gage pressure or differential pressure. For special applications, transducers can be designed to withstand temperatures up to 600°F and pressures up to 75 g and operate in corrosive environments. Transducer is linear to within 1/2% over entire range according to manufacturer. Cohen Laboratories, Inc., 344 Cleveland Ave., East Orange, N. J.



• **Solid-state commutator, Series K3/35**, for universal timing is available in standard scan rates of up to 25,000 cps and is capable of accommodating from 2 to 100 channels. Input signal range is 0-10 mV or 0-1 v, with outputs of 0.5% of input signal. Commutator is linear to within 0.2% and has maximum output resistance of 25 ohms. Manufacturer: Electronic Systems Development Corp., 1484 East Main St., Vista, Calif.

• **Variable temperature coefficient isolator, zero noise type, with temperature coefficient that can be changed from 10 to 4,000 parts per million per degree Fahrenheit in terms of noise density adjustment without change in insertion value, are available for use as transducer circuits where designed into temperature-compensating systems.** Model 704 "Temp-Vari" microwave isolators are available in simple quantities at \$15 each. Manufacturer: Corad and Corcoran, Inc., 5180 Goldfield Way, San Diego 5, Calif.



• **Transistor overload current limiter protects transistors against damage due to current overload, surge currents, heat and recovery and overvoltage punch through.** Device provides load current detector sensitivity of 200 mV at 70 ohms load and a turn-off time of 10

INFERNO...

CONTROLLED

B-70's high speeds and tremendous cooling loads pose the most demanding environment control problems ever encountered

At 3,000 mph, skin temperatures of the USAF/North American B-70 will soar as high as 600°F. Yet the crew and avionics gear will function in ideal temperatures—from sea level to 70,000 feet.

To solve the plane's extraordinary operational requirements, Hamilton Standard is developing the most advanced and comprehensive environment conditioning system ever planned for an aircraft. It will provide completely automatic:

- cooling and pressurization of avionic gear and crew compartments
- emergency ram-air cooling and pressurization
- temperature control for drag-chute and landing-gear compartments
- weather removal
- no-contaminant control

MAIN COOLING for crew and avionic compartments is provided by a closed vapor-cycle/air recirculation system and several closed loop transport systems.

THE B-70 PROGRAM is an excellent example of Hamilton Standard's unmatched systems capability in environment conditioning and control. It encompasses skills and experience the company has amassed in creating systems for such advanced aircraft as the F-104, F-105, B-58, B60 Jet Line and over 40 other leading military and commercial planes.

CLOSED-ENVIRONMENT CONTROL SYSTEMS for space vehicles are also under study at Hamilton Standard. Current research involves a variety of equipment, designed to reason and anticipate air requirements from a sealed capsule. Object: to create a safe air supply for man in space.

FURTHER INFORMATION on current Hamilton Standard environment programs and services is available. Your inquiry is invited.



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GROUND SUPPORT EQUIPMENT Hamilton Standard is presently producing a wide range of GSE for both military and aircraft—test special tools to complete systems.



ELECTRONICS at Hamilton Standard includes broad experience in flight control, instrumentation, direct power systems and electrical control for aircraft, missile and GSE components.

DATA AND CONTROL SYSTEMS

Young Company Surprises Industry and Competitors with Early Breakthroughs

Breakthroughs. A relatively young company, Data Control Systems, Inc., has stolen the march on competitors with the production of the industry's first solid-state discriminator. In addition, the company has been in production for some time on a voltage-controlled oscillator, the *MOV-4*, which has been described as the "best in the industry," and a low level, variable waveform oscillator, the *MOV-10*, which likewise appears to surpass anything currently on the market. Moreover, the company has just announced a new high speed version of its electronic counter-timer, to meet the industry's coming requirements.

• **Data Control Systems** was formed on October 1, 1967, just a few days before the announcement of Russia's Sputnik 3. Since that auspicious day, the first original founders, including Dr. Robert J. Jeffery, a former president of the Instrument Society of America, have built an organization that today employs some 275 people. The Company's Research and Engineering Department, under the direction of Mr. Raymond A. Ruppert, totals approximately fifty persons, and includes many of the country's outstanding designers of electronic data systems and measuring instruments.

Proprietary products include complete FM/AM telemetry systems and ground systems including fixed and portable subcarrier division systems, electronic oscillators, impulse type speed computers, amplitude-voltage-controlled oscillators, string-gate oscillators, electronic communication calculators, variable bandwidth systems, scoring devices, data display devices and remote control links employing radio and wire transmission.

• Several complete ground-based data-acquisition systems designed and built by the young firm for the Boeing Aerospace Company, Seattle, have just been delivered, and will be used for the RAD-light test program of the "Minuteman" (ICBM) Order series of missiles of DCS' Seattle Airport General, Arana, Cleveland, OH, Lockport, Douglas, North American Aviation, and Martin, in order to maximize military reliability and accuracy research centers.

• The new solid state FM/AM discriminator, Model CVD-4, exhibited at National Instrument Exposition in Space Electronics and Telemetry in Washington, D. C., a broad acceptance of the research in this field that DCS has perfected from its very inception. For detailed information on its products, including, etc., contact DCS directly: Dept. AW-10, East Liberty Street, Danbury, Conn.



DATA CONTROL SYSTEMS INC. President Robert J. Jeffery (left) checks installation of company's new instrumented subcarrier discriminator in Minuteman telemetry ground station test prior to shipment while R. A. Ruppert, V. P. of Research (right) and R. H. Hyde, Manager of Marketing, look on.

FOUR DCS PRODUCTS TERMED "WORLD'S FINEST"

Dr. Robert J. Jeffery, President of DCS, describes his company's latest breakthroughs in these words: "We herewith believe that the Discriminator, Oscillator and High Impedance Counter-timer just announced represent the finest instruments of the type available today, from both manufacturing and state-of-the-art standpoints. We are proud to add them to our growing list of standard products which are bringing new standards of performance to research instrumentation systems."



DDC-4: Solid state stopwatch phase lock loop discriminator has low power consumption, high power and highly linear, ultra stable, extreme reliability.



AFDC: Solid state electronic discriminator has most important features for noise and error rate. Unique modular construction permits rapid change of match points and sampling rates.



MOV-4: Solid state voltage-controlled oscillator, long term stability, zero frequency, low distortion, wide temperature range.



MOV-10: Solid state variable waveform voltage controlled waveform oscillator best performance of DC amplifier and VCO are simple momentary plug-in switch for status pages, thermocouples, etc. Ultra stable over wide temp. range.

then one microsecond per sample to record selected break data. Total is equal time to interrupt at 50 microseconds. Controls on the CR-20 include preset selection of current limit from 2 to 20 amp, break delay time to allow for filament or capacitor warm currents and selection of automatic or manual breaker reset. Manufacturer: Mallory Electronic Division, Indianapolis, Ind.

• **Manitex** made ultrasonic speed at speed of 0.005 sec. weighs less than 5 oz. Device provides Type "N" straight through control connection where voltage (25 v. d. c. to 115 v. a. c., 400 cps) is applied and becomes a 20-



db bi-directional attenuator, audible from 70 db to 5,100 db, when voltage is removed. Device reportedly meets MIL-E-6771C. Manufacturer: Den-Lux Electronics, Inc., 1151 Olympic Blvd., Santa Monica, Calif.

• **Stange-type** oscilloscope, Type 418, known as "Storoscope," permits display to be frozen for periods of minutes or days and erased when desired. Storing tube need couple a P18 phosphor which produces dark trace on a light background. Erasure requires a maximum of 17 seconds with a non-erasing



how do you play the numbers game?

This circuit enables game consists of adding low value components you can wedge into a small space. But there's a catch to it.

Some added modules may seem small until you strap them together and find that interconnections and supporting structure take more space than the modules themselves. That's why it's important, in making interconnections, not to consider the module size alone, but to be concerned with the overall size, including brackets, interconnections, and supporting structure.

New **LECO MINIFIELD** device modules are designed with overall systems size in mind. They offer optimum interconnection with only a minimum of extra circuitry and supporting structure. Add to this the availability of precise elements constructed using available standard voltage components rather than hard to get specials, the superior strength of welded rather than soldered connections, and you have an unbeatable combination of advantages.

We invite you to see for yourself at Booth 400, New York 1968 Show.

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You'll find within the 28 pages **fuzzy** emphasis on ergonomics and the fit with ongoing routine. These cover such aspects as component design, loads and rigid elements, stress management and application, special equipment and all sorts of other "kitchen for nature." Then through the



guide to selecting the proper tests for given statistical applications. Putting it up still further are tables of physical and chemical property data on the "Scottish" part of each of seven.

This book is a must collector's item. Why not call off your dog and read something positive by giving your own copy? Just check the box below.

If you've been anxious to get radioactive isotopes to track, for you too have been told they may end up working on you, this will be a welcome bit of news. These few little personalities have been trained in a way that makes them even more useful and get automatically rid of the breeding habits. The animals are usually kept in tiny concrete bins, approximately 30 meters in diameter. The union between cottons and animals is actually a chemical bond, which is

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miscellaneous solvents, chemicals, and even the human digestive system from leaching out the radioactive material. The Central Research Laboratories have refined the process to such an extent that they can now treat almost any of the radioactive wastes.

The producers, largely in Redwood Manufacturing, find themselves with a variety of industrial and medical applications. Being uniform in particle size, and free flowing, they can usually be incorporated in a variety of products. They are in demand for film stockroom and demand to be used in low adhesives in a variety of products. They are also used in a variety of products.

Now do the possible and that's, the Redding Microplate can form self emerging formation measurement data, you can. Let us Control Research Laboratories tell you how Redding Microplate can brighten your future, too - by showing the way to the future.

It may seem surprising to talk about paperwork in the highly sophisticated aerospace industry, but correspondence is what this firm does for the business.

3M Company, Music Industry Liaison—Dept. VAC-00
St. Paul, Minn.

Please send ☐ information request on "SearsRoebuck" Electrical Repair ☐ information on Radiant Micro-splitters ☐ facts on "Therma-Flex" Coping Machine ☐ 3M Products for the Automotive Age.

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men's burden. Indeed, we wonder if a pound of hardware isn't accompanied by a pound of correspondence! There are two bad features about this apparatus of paperwork. One is the time required to handle it and the other is the space required to store it. Our Displacement Products Division has come up with two time and space savers, able to help you solve your paper work problems.

One of them is the technique "Printer Ready-Print" for setting movable type, making metal composition proofs. It was described in an earlier issue.



The other is an idea called the Short Note. Briefly, and sometimes known as the SNR, it is a note that is written on a little bit of paper which requires a short reply. Instead of dragging an answer and putting it into the same post, you simply write your answer at the bottom of the story of the letter. A dry copy is then made on a "Thomas-Fox" Copying Machine and returned to the sender. You have the original for you; Ed and I have a copy for us. After your weathered SNR, the copying process takes only a few seconds. For more information on this fast saving method of handling correspondence, contact "Thomas-Fox" Copying Machine, Inc., 10000 13th Ave., S.W., Seattle, WA 98148.



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MISSILE
INTERVIEW
LEADIN

40-psi. Device can also be used as a conventional dynamic overfillage. Storage tube life is expected to average about 1,000 hr. Overfillage headwidth is normally 80 lb or both ways, with spot size of 0.005 in. Writing speed is 10,000 cps./sec. Manufacturer, Allen B. De Mott Laboratories, Div. Percelec Corp. and Instrument Corp., 790 Bloomfield Ave., Clifton, N.J.



★ **Lucas switch**, Model 6UD-RE5 will operate when subjected to postseismic horizontal forces of 1g to 2.5g, within a tolerance of 5% of setting. Device has only one moving part, a permanent steel ball held against a solid base by a uniform magnetic field (the move is done with one switch which influences its semicircular switch repeatedly such SHLE-5272 and operates over temperature range of -85°F to 200°F. Manufacturer: Lucas Switch, Inc., 111 West 42nd St., New York, N. Y.

• **Bandpass Filters**, available in frequency range from 20 to 1,000 Hz, occupy less than 13 cu in. and weigh only 4 oz. Multi-stage filters have reflector assembly kit or Telebristol suspension characteristics, giving up to 35 dB signal rejection at one bandwidth trans-



filter's center frequency. Bandwidths range from less than 1% to more than 50%. Maximum insertion loss is provided is less than 1 db. Filters are designed to meet MIL-E-5408 and MIL-E-5422. Manufacturers: Micron, Inc., Special Products Dept., Alameda

*Low-cost digital computing unit, Model 3-103, for data processing, instrumentation and control performs digital computations in an architectural model that provides 100% accuracy.



operations with typical speeds of 5,000 additions or 775 multiplications per second. Denac includes regional programming and control, self-checking circuits, and power supply. It is designed for standard 19-in. wide rack mounting, with panel height of 55 in. and depth of 82 in. Price is \$4.50.

POB Los Angeles. Manufacturer: Applied Development Corp., 13516 Wilcox Way, Hawthorne, Calif.

*Sedimentation ultracentrifuge Model 680 microchloride type, measures cells in high and weight oak 4 gress. Temperature response is 1 cps to 10 K, with maximum frequency of 115 K. Maximum acceleration is 40,000g, with amplitude linear to within 1%. Operating temperature range is -60F to 300F, is up to 500F on special order. Manufacturer: Columbus Research Laboratories, Macland Blvd and Balfour Lane, Worthington, Pa.



for High Performance target and control flow is satisfied.



Experiments were carried out in the following order:

pariret ardeale grasse
 bene attese
 in lei grasse: gli altri si staccano
 sempre meglio

More choices available for your flight configuration



from under the seas... to the edges of space... and beyond



VAP-AIR MERC THERMOSTATS

Vib-Air Mats have many uses, widespread acceptance

[illegible]

have proved outstandingly accurate and dependable for the most critical thermal sensing and control applications in missiles, aircraft, ground targets and underwater environment.

The Army District Medical Agency has for two years accepted New Haven as standard temperature control sites on all their wounds.

Time after time, Yupo-Air mercury tube thermometers have proved their exceptional ability to meet the most exacting specifications for thermal sensing and control. Small, lightweight, they are unaffected by altitude or moisture, and are as tough as our well-known 130-G shocks and 30-G vibrations without loss of accuracy. They have fast response, close limit tolerances, wide operating ranges, and undeviating accuracy to provide millions of cycles of reliable operation. Merits need only simple circuits, are adaptable to virtually any need.

of the previous year. Total sales for 1999 were \$89,011,255.

Manufacture and operations of the Poroson Dismen have progressed compared with that division having recently entered a new era of application for its home equipment for engine training of personnel in the branch, operations of air-to-surface missiles and divers.

With respect to the Borsac cargo crane program he said that the two- to four defense appropriations bill is the first approved provides funds to continue production of the Ogden Daunt until mid-1992. Borsac cargo development work at Van Nuys will be completed by the end of this year.

"One result of such efforts has already been obtained in a contract for the development of a new target engine for an Active target drone. This program is of particular significance in that it provides a new application for the target engine as well as a new type of air platform—the U.S. Army's

Robert Farris Inc., Chicago, Ill., managed the sale of the project for Mountain View, adding over 750 sq. ft. (50,000 sq. ft.)

[illegible][illegible]

Thomas Procter Division, Thompson
Rome Metalizing Inc., Cleveland, Ohio
Manufacturing plant in Ohio and 1740
20-44; 21-150

United Instruments Division, Westron
Inc., Nevada, U.S. Indicator systems
division, P.O. Box 100, 89507, Las Vegas,
Nevada. 17-100, 17-101, 17-102, 17-103, 17-104,
17-105, 17-106, 17-107, 17-108, 17-109, 17-110,
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AMC Contracts

Wright Patterson AFB, Okla.—Following is a list of unclassified contracts for \$25,000 and over as released by the Air Material Command:

Therm Tech Co., Inc. (Pittsburgh 2204)
High vacuum pressure systems up to 100
inches and 175,000 psi. 412-244-
1100.

Universal Controls Corp. (Pittsburgh 2011)
Temperature control, high or ultra high
vacuum. Areas 10,000 sq. ft. or less. up to
P-100, P10000 and P-9000. 412-244-
1100. TW 31-0000-0000. (Pittsburgh 2011)
C-1010, C-2-000-0000 and C-2-000-0011,
412-244-1100.

West Inc. (Grand Rapids 2100) (Grand

1. F01 computers, systems, or systems
 2. Model 90 and 900, type 2001, 2002, 2003,
 2004, 2005, 2006, 2007, 2008, 2009, 2010,
 2011, 2012, 2013, 2014, 2015, 2016, 2017,
 2018, 2019, 2020, 2021, 2022, 2023, 2024,
 2025, 2026, 2027, 2028, 2029, 2030, 2031,
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Bio-Engineering Kleinfelder Corp., Universal,
10000 Canyon Boulevard, Suite 200, Denver, CO
80231-7699. Tel: 303-751-1000. Fax: 303-751-1001.

[illegible][illegible]

Shift for Navy's 'Big Dish' Telescope
Shift weighing 120 tons will be the heaviest point for Navy's 500-ft. 'Big Dish' radio telescope. Shift contains 9 ft. in diameter and a 154 ft. high. Mounted on the shift and being worked on a large boring mill is a steel-plate flange welder, which shifts the shift in the main boring mill. Edgewood-Kaiser-Henderson Corp. is building the main base structure at its Edgewood, Pa., facility.

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NEW \$3,500,000 FACILITY ANNOUNCED BY VOUGHT ELECTRONICS

On July 21, Vought Electronics broke ground for a new \$3.5 million facility in the Great Southwest Industrial District, midway between Dallas and Fort Worth. Completion date for the ultramodern 50,000 square foot building is January 1963, with expansion to 175,000 square feet projected within the next few years.

Complete Electronics Facility. The completely self-contained facility will house engineering, assembly and manufacture, quality control, marketing, finance and administrative areas. Also included will be five laboratories—thermal guidance, servomechanisms, fluids, microwave and superconducting—all with advanced equipment.

Diversified Products. Recent major Vought Electronics contracts include production of actuators for the Minuteman ICBM, factory checkout equipment for the thermal guidance system of the Titan ICBM, guidance systems and adaptors for the new Crusader F4U-80N fighter.



B. H. Gued, general manager of Vought Electronics (left) and A. G. Wyner Jr., president of Great Southwest Corporation, check out new facility.

Among other new products are an aircraft navigation system, space vehicle guidance units, ASW devices, advanced antennas, a commercial fingerprint identification system.

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Boeing Builds B-52H Electrical System Mockup

Portion of complete set, and the electrical power distribution system mockups for the Boeing B-52H and the new B-52H missile launchers are shown in Electrical and Electronic Design Laboratory at Boeing's Wichita Division facility. Work is centered on collection of the 128 bus system for the B-52H. That system includes complete aircraft d.c. power system including load simulation capabilities.

N. Y. representatives of type L-8 in type B-52H system include, in the form of a B-52H aircraft, 1700 (20 B-52H) 141,000.

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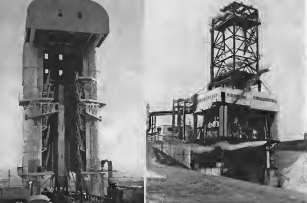


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TEMPORARY mobile working tower provides a ladder for static test firing of rockets (left). Paved exhaust lanes nitrogen bathes. At right, engines are being loaded for a test run. Insulation insulates static load pressure of propellants.

TURBOPUMP test tower work on a regenerative cycle. Gas generator test cell (right) have been authorized. Turbopump tower (left), which contains an early model of an Aron turbopump engine for driving propellant inlet system, has not been used.



MISSILE ENGINEERING

Blue Streak Motor Records 300 Firings

By John Trentall

London—More than 300 test firings of Blue Streak's RZ 2 MB, 2 motor motor were successfully made at the Spadecore rocket test and development establishment before cancellation of the Blue Streak missile program last April.

These are known in large measure a number of firings with duration of 74.31 sec of the two motor motor. At least one run has been made in recent weeks of considerably longer duration to prove the capacity of the system to meet a space vehicle launch requirement.

At peak periods consumption of liquid oxygen reached 100 tons a day—the peak capacity of the storage system production plant installed on the site.

In spite of the cancellations, test firings have been continuing at a reduced rate of between three to a week, but testing of the gas generator and other components has been stopped and tests of the gas turbopump and are being concluded, pending a government decision on a British space program.

Engineers here said that in effect development work on the current MB, 2 engine had been satisfactorily concluded and that the current in component development work concerned little models at the motor.

First Firing

The vehicle was recently given its first public test firing at Spadecore but after a successful firing sequence the two 135,000-lb thrust motors were automatically shut down after barely registering a missile. Control was triggered by "bad luck" occurred, resulting in the major nitrogen pressure and flow parameters.

In this test the following parameter was the pressure buildup in one of the propellant supply lines. But the same engine was successfully ignited two hours later and ran for 24 sec.

According to the test engineers it was only the second pressure control in the last 30 firings of a two engine engine.

Most of the installations and the instrumentation now widely dispersed on this wild and hazy 10,000-acre site in the Cumberland Fells stretch below U.S. justice Mediterranean, where their cars are stored largely to effect an economic in transport and equipment.

The site was developed with a poor and priority which surprised that offered any previous British government.



ENGINE test tower at Spadecore is used in a temporary mobile working facility.



COOLING post holds 1 million gal. below is engine control blockhouse, centrally located.



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ROCKETDYNE AND SOUNDCRAFT INSTRUMENTATION TAPES



At North American Aviation's Rocketdyne division, the recording of rocket engine performance on static tests, calls for the use of only the most reliable of instrumentation tapes, like Soundcraft. Why? Because Soundcraft Instrumentation Tapes combine exact physical and electrical properties as necessary to assure absolute reliability of performance—as a direct result of being manufactured in the world's most modern tape plant under the most advanced quality control system.

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BLUE (STREAK) rocket motors are shown on assembly line in engine building shop. Testline is apparently an inlet flow type and accepts hot gas from generator located under exhaust elbow (note engine on stand at left and below). Engine is mounted on environmental pedestal.

growth at military establishments including those built to support the crash program behind the buildup of Britain's nuclear industry.

It was scheduled to cost about \$62.5 million. At least \$12.5 million has already been expended and all the material and equipment in the original program has been procured.

The major facilities include two main test stands with test engine rooms and equipped for static test firing, and two engine test and development towers.

Costs Cut

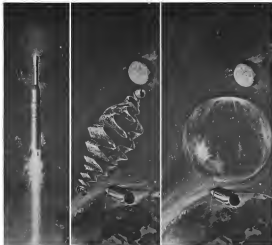
One of the major towers is complete and the other well advanced. Those of the engine towers are in service. The fourth represents a major departure from U.S. practice and involves a switch to reinforced concrete which has cut the cost to about one third that of a conventional steel tower.

In another case component testing and assembling is carried out in nine test cells grouped around a central blockhouse from which the tests are instrumented and remotely controlled. On the same site is the largest flow calibration facility in Europe. All this equipment is in service.

Liquid oxygen from the British Oxygen Co. storage air distillation plant installed on the site is delivered to storage vessels in each of the three test areas. Gaseous nitrogen from the same plant is piped through a ring main at 1,380 psi.

Loading rocket engines at Space-





Nike-Cycle rocket engine payload for first test firing.

At altitude, engine is released before test, followed by test motor.

"Project Echo" satellite in orbit, ready to reflect radio signals from NASA transmitters on earth.

New plastic moon lets all our scientists share in satellite tests

Your voice may "echo" around the world as a result of this cooperative Space Age project . . .

"Project Echo," National Aeronautics and Space Administration satellite launch, comes like a "vanguard" research grant to scientists.

The aluminum-coated plastic sphere went into orbit today inside the nose of a Douglas Thor-Delta. Researchers have been invited to share their own experiments with the aid of radio signals bounced off the satellite by NASA transmitters. Data

on the orbit and signals is being widely published by NASA in the belief that "cooperative tests" can result in new civilian space research advances.

Such satellites may one day be used as global relay stations for radio, voice and TV signals. While this system is not a reality, the booster that can put it up already is. Douglas Thor has proved itself successful in 80% of all space flights. This dependable launcher is another product of the imagination, experience and skill Douglas has gained in nearly 39 years of missile development.

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NIKE-Cycle engine development tower was designed to test in heavy instrumentation.

also sold Anasirum Works that the Nike-Cycle design modifications to the Rocketdyne motor have given the British version the edge over the 33 engine family. "It is no longer a one-way selection deal," said a Nike expert.

One of the principal difficulties between the two vendors lies in the propellant control details which in the case of the British engine have to be extensively revised in Blue Streak is not fitted with vacuum nozzles. This has led to the development of a new nitrogen-operated control valve with a response rate of which Rocketdyne is "extremely pleased."

Rocketdyne also says it has considerably improved the performance of the turbocharger used by the application of both design and fabrication details from existing company gas turbine and blower technology. No details of the motor have been released but inspection of the radio unit indicates gas flow from the propellant in a vertical direction to an axial two-stage turbine. Gas temperature is at the order of 600C. The Rocketdyne motor system configuration is, however, unchanged.

Fuel flow is a complexity of parallel jets along the nozzle, feeding new jets in each direction as adjacent ducts which form the nozzle.

The propellant is injected into the combustion chamber through an injector diff. The argon is believed to enter through holes in the center of the duct and the fuel ejected through narrow concentric slots on the diff. face.

The instrumentation on the rocket motor is spread to cut out any test firing if continuation of the missile due to rough combustion fall below 200 g's. Effects of frequencies up to 7 k are being investigated in the engine test program.

Work first began on the Spacecraft

in January, 1957, and was sufficiently advanced for the first firing of a No. 2 motor about a year later.

Prior to this test, engine development on a more satisfactory motor believed to be designed by the RAE, was carried out at Westcott rocket research establishment near Farnborough.

Send members on the 10 rocket motor in the motor assembly shop suggest that about 124 motors have been built.

Genie Shelf Life To Be Extended

Los Angeles—Major improvement program for the rocket motor of the Douglas M-1 Genie is being pushed to phase a revised version of the rocket motor, which was acquired in 1954, into the Air Force's tactical aircraft and early next year.

AvcoGeneral, an subcontractor under a USAF development contract in Douglas, is studying the engine most to provide.

•Solid-propellant rocket motor with substantially extended shelf-life, to increase the time span for effective Genie use.

•Low-temperature operation capability exceeding that of a solid-propellant rocket of comparable size.

As prime contractor, Douglas also has proposed to the Air Force another improvement program leading to an advanced version of the Genie, which might extend the vehicle's operational use for to seven years and provide increased kill potential against targets incorporating air-cooled electronic countermeasures techniques and high and low-altitude and high speed capabilities.

The proposal stems from a Douglas-

headed study and provides for adoption, without major engine modification, to Genie-carrying interceptors.

Consistently more than 2,000 Genies already have been built and delivered to the Air Force by Douglas for use in the Northrop F-89, McDonnell F-101B and General F-106. There is a good possibility that Genie was also selected for serving foreign interceptors type aircraft.

Production of the Genie probably will extend through 1961 in accordance with present government projections.

Navy Awards Bendix PMR Service Contract

Navy has awarded Bendix Corp.'s Radio Division a \$1,600,000 contract to operate an aircraft electronic equipment on Wake, Eniwetok and Midway Islands used in atomic bomb tests and satellite receivers and to perform other operational services in the Pacific Missile Range.

Bendix will also operate the Kaseko Communication Center in Hawaii, which connects downrange aircraft with range headquarters at Ft. Meigs, Calif., and will be in charge of two Navy receiver ships, the Delton Victory and the Bain Victory.

The contract covers the extension of technical services which the Radio Division has been performing over the past year. The company has established a headquarters office in Honolulu.

Cook Electric Awarded ICBM Base Contract

Atlanta communications system for three Titan ICBM bases will be built by Cook Electric Co.'s Advanced Communications Engineering Division for USAF under a \$4,745,000 contract awarded in Rome Air Materiel Area.

The company will be responsible for all phases of the communications systems, such as instrumenting, engineering, construction, checkout and maintenance.

Grumman Gets Contract For Eagle Airframe

Grumman Aircraft Engineering Corp. will produce the Eagle missile airframe, propellant motor assembly and modify the existing Douglas ASD (AW Sec. 12, p. 145) under an \$8,754,534 subcontract awarded by Bendix Corp.'s Electronic Division, prime contractor for the Eagle missile system.

Grumman also is developing ground-handling equipment for the Eagle long-range anti-air system.



CASE HISTORIES



Forced high temperatures, full compressor N/D ball bearing, rate of shaft base of 1000 rpm operates successfully at high temperatures with no need for lubricant protection.



Photo Courtesy: United Defense, Fairfield, Super and Aerospace Corp.

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Extensive testing proved that this N/D aircraft modulating system, currently used on the Lockheed Hercules C-130A military transport, operates at required standards of performance and reliability — and without lubrication! In addition, other New Departure ball bearings, selected for their unsurpassed reliability, are used to support the turbine main shaft which operates at 48,000 rpm.

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NOSE of Cessna Vought escape capsule within actual F-101 Crusader forward section modified to provide additional space needed for improvement of ejection, stabilization and parachute recovery system. Forward section in front of pilot (right) is being provided in capsule to replace escape and future operational flight requirements. Note access cutaway at right. Thrusts in circle left hand.

New Escape System Detaches Nose Section

By Evans J. Ruffin

Dallas, Tex.—Improved survival characteristics in addition to bettering the combat pilot's tactical capabilities are given priority in an integrated cockpit escape capsule development here under Navy sponsorship.

Cessna Vought Aerospace Division engineers feel that the philosophy of detaching the entire nose section of the aircraft in an emergency would make possible a lighter survival system than is possible with the seat ejection principle, since they feel that little additional structural buildup is required to the already normal tapered construction of modern supersonic aircraft to maintain integrity of the capsule in landing. Also, retention of the pilot in the escape system, as designed here, makes possible greater opportunities of his light ejection.

Cessna Vought's escape capsule concept developed under its actual Navy contract taking more than \$1 million in a full-scale windup form, utilizing an actual nose section of an F-101 Crusader fighter, modified to contain the separation system and ejection environment system. Induction of the surface in a fighter of this size could be done at a cost of approximately 400 additional pounds, compared with conventional ejection system which, with seat and pilot's personal equipment, weigh approximately 500 lb., and the aircraft high-speed system going into the next generation of operational combat air-



STABILITY study of escape capsule is shown in high-speed surface picture of model in Cessna Vought low-speed wind tunnel operating at well over Mach 3. System is designed to burst capsule some 150 ft. above aircraft for maximum safe separation.



Guidance: Key to maximum Pms in space

As space technology advances, the character of space missions will become more and more sophisticated. High Pms (probability of mission success) will be increasingly dependent on precision guidance.

A major role in space guidance will be played by the gyroscope—the basic navigational reference for things controlled by such related technologies as space-inertial digital computing, TV-inertial platform systems, remote-control inertial systems, IR sensing, and radiation resistant devices. In all of these, and in associated systems studies such as evaluation of Pms and of overall system dynamic stability, Sperry is actively engaged.

With its unparalleled background in guidance and control over five decades, Sperry is today laying the groundwork in research, and in practical experience, for the sophisticated guidance requirements of tomorrow. Now in design or development stages are such basic landing and complementary guidance systems and controls: boost mid-course, re-entry and terminal guidance; self-adaptive flight controllers; space acquisition radar systems and rendezvous controls.

These contributions to "maximum Pms" in space exemplify Sperry's overall scientific capabilities—capabilities that reach into every stratum of our environment today—and far into the future. General Office, Great Neck, N. Y.



SEA • SURFACE • AIR • AEROSPACE

SPERRY

craft, which weigh some 665 lb., Chrysler-Vought engineers say.

They are among at least 100 designs which they believe would bring the entire weight of a fighter escape capsule to approximately 7,000 lb., including the aircraft structure in the event.

Sperry is designed to provide "flexibility" convenient for the pilot during the entire flight mission including separation from the aircraft in emergency, from maximum operational altitudes to below sea level, if necessary, the latter case taking account of crash into the water during carrier landing and islands.

Superevating Seat

One of the key features in providing this movement is a superevating seat which adjusts automatically depending upon stresses forces exerted by the pilot. The superevating seat, braced at a single point at the seat back and pneumatically operated, seats the pilot into the accelerometer. Range of adjustment currently considered is from 11 deg. forward tilt to complete uprightness of 65 deg., with the pilot retaining constant head position relative to his seat back. Sperry, designed to aid the pilot of the need for wearing conventional pressure-type suits, will permit pilot to make much tighter turns and sharper maneuvers than now possible. Acceleration Driven project requires six. How much more superevating the seat provides over g-forces is difficult to estimate, since it depends as much as individual tolerance—but this, feel the engineers will be considerable.

Frage pressure is handled by a belt of specially designed shaped charges adjacent to the aircraft structure and interior, which makes electricals, who said with the forward cockpit portion of the aircraft free from the remainder of the structure. The system has been tested successfully by Navy, according to Chrysler-Vought, using actual Chrysler fuselages enclosed 10 ft underwater in the Naval Weapons Laboratory, Dahlgren, Va.

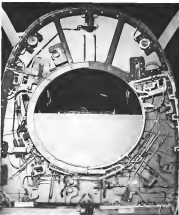
Instrumented Tests

To test possible effects that explosive charge deflections underwater might have on an occupant of the capsule, the subject was instrumented. Tests indicated that despite the fact that there are these small charges, water, employed to magnify the detonation effects, they would have no adverse effects on an occupant.

Several separation methods are employed to provide controlled and automatic ejection of the capsule to cover regime from high altitudes to underwater. Normal separation would be achieved by the pilot using one or two forward portions of escape capsule.



COMPLETED scale model of Vought X-44 escape capsule was applied to National Aeronautics and Space Administration for trajectory studies.



SHAPED CHARGE separation system developed at Chrysler-Vought for testing capsule crash from altitudes of 10,000 ft. above. Electrical initiation of charges was shown for automatic ejection system in designed details.

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From van B. P. Grooten et al. in *Journal of the American Medical Association* 285:1111-1117 (2001).



Wings Assembled for First Boeing B-52H

Wing assembly for the first Boeing B-57H night bomber seen completion at the company's Wichita, Kan., Division plant. The B-57H wing still may hold fuel and Strategic Air Command's new Skybolt air-launched ballistic missiles.

toris. Shaped charges then cut the capsule into two immediately after the accident. Four stabilizing fins are effective passively, activated to prevent the capsule from tumbling. This has a built-in 90-deg yaw rate to overcome an inherent 45-deg yaw (pitch) yaw moment of the capsule on separation. In addition, line of action of the drag chute impacts a further 20.25 deg pitch up

Capsule Summary

Boosting the spindle positively from the segmented remainder of the system would be done by two 15,000-lb thrust rail rocket motors, with nozzles canted 45-deg downward. A Naval Ordnance Test Station study, "The rocket motor must" employ a single wagon-haul (suppose) grain of 7.5-in. diameter and 28 in. length. Overall length of rocket nozzles would be 36 in. diameter 5 in.

Fast stage parachutes would deploy at

or below, approximately 60,000 ft to give the capsule. At approximately 15,000 ft, the recovery chute system, comprising three canopies, would open. Capsule would also utilize inflated bags collapsible on impact, to take landing shocks. Systems are designed to provide pilot with ability to reduce hazards of exposure by maneuvering in the capsule, until rescue.

Swallowing components occur during takeoff as landing. The separation is a square slope displacement of the drag curve, reducing time to deplete mass recovery charts. In event of pilot brain incapacitation, an automatic, dual-engine, switch-over mechanism is employed. Pilot might employ this in combat or various. System is activated, but control is retained by pilot's hand pressure on the side-rod controller. Should he release his pressure, the separation and recovery sequence starts in three seconds, although he can halt activation.

any time within this period by again
servicing the controller.

Survival to crest of a trash into water during carrier landing at takeoff would be provided by a water sensitive switch which initiates the recovery system.

Final phases of the company's satellite development contract entail firing of three-foot models of the integrated capsule at subsonic and supersonic speeds at National Aeronautics and Space Administration's Wallops Island, Va., stations later this year. Models will be rocket-propelled and telemetering equipment will provide data on stability and acceleration forces on the models.

Proposed programs for follow-up development includes:

• **Detailed engineering** of the capsule, also a pilot environmental test series, which would be handled at Navy facilities. A life-support system to provide necessary oxygen concentrations and cockpit pressurization, allowing need for personal oxygen mask or pressure suit, would be manufactured and evaluated in the low-pressure chamber at Navy's Air Crew Equipment Laboratory, Philadelphia, Pa.

- **F101** antistress system would be tested at the upland and basement acceleration facilities at AFCE. The supraphag test would be tested at the Aeronautical Medical Acceleration Laboratory, Johnsonville, Pa.

- Rocket sled tests would be able to study separations of the capsule from the airframe, flight stabilization and the parachute recovery systems to simulate speeds those related to reentry.
- Final phase of the program would entail three actual ballistic re-flight separations from an F1U aircraft, two of which would utilize dummy capsules fitted with dummy pilots and a final test using a live subject.

PRODUCTION BRIEFING

V&E, Colombian (combined alloy), is one of the newer materials being welded and analyzed by Ling-Temco Electronics, Inc., Dallas, as part of its work in the USAF Refractory Metals Structural Development Program. These programs involve fabrication and testing of welded components such as turbine housings or cylinders and their joining under simulated service environments. Colombian offers promise because of its ability to retain useful structural properties up to 2,500°F. First test specimens made by Ling-Temco in welded joints at Eastern 52, a subsea test facility, were subjected to stress and corrosion, which was followed, spot and fusion-welded joint assemblies.

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Mock-up of Project Mercury capsule built for McDonnell Aircraft Corporation by the national school flight program of the National Aeronautics and Space Administration.



The "Big Joe" test firing, full scale model of Mercury space capsule test launch 180 miles high over the Brown Mountain test range, sponsored by a B.F. Goodrich contract plan. Also will carry high speed infrared video cameras to Queen of the Desert.



SUITING UP THE ASTRONAUTS The pressure suit to be worn by the astronauts are now being fitted by B.F. Goodrich. The suit must maintain enough pressure to keep a man's blood from boiling, must provide air to breathe, must protect against burning heat. In the bargain, this pressure suit is light weight and flexible enough to allow free movement.

HIGH ENERGY SOLID PROPELLANTS The solid fuel used in one of 30 operational satellites in the B.F. Goodrich solid propellant plant, currently processing and loading solid fueled motors of the LOX, KTV and ASF types. BFG pioneered the development of the major polymeric binder-fuels now being used in the most advanced missiles.



B.F. GOODRICH ABLATION SHIELDS ARE USED ON THESE U.S. AIR FORCE/GENERAL ELECTRIC SPACE VEHICLES



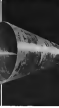
BFG's Rocket Research Vehicle, the largest ablation shield in space vehicle to be launched by the national test range.



BFG's Rocket Research Vehicle, the largest ablation shield in space vehicle to be launched by the national test range.



Mark II, an advanced rocket motor vehicle to be launched by the national test range.



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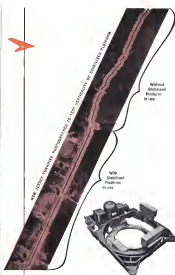
MORSE **BW**
A BORG-WARNER INDUSTRY

Corp.'s switch to numerical control for fabrication of Polaris test- and zero-launch hardware. Ability to machine wall thickness to plus or minus two thousandths (wall height is 14 in. per part), the constant wall, and tolerances were cut by two-thirds. Couplings but even could be either template or model checking techniques were eliminated by Aerojet's switch. Production lead time was reduced and design changes could be fed in more rapidly with numerical control. Looking to the future, Aerojet says that costs are competitive with former low-cost production techniques that numerical control will be used on other Polaris aerodynamic testing processes, and that parts from several vendors using numerical control should be identical.

Stratos Division of Fairchild Engine and Airplane Corp., Box 3500, T. I. N. Y., has received a \$784,875 contract for study to supply and test a subsonic aircraft on the flight deck of the USS Enterprise, nuclear-powered aircraft carrier. Units will deliver 90 lb per minute of cooled air at a discharge temperature variable from 71F to 719F. Heated water separator is part of the unit. Design life is 10,000 hr between overhauls and 2,000 hr without oil change.

Tels Cook Company engineers are studying aircraft and engine applications of a new technique for forming corrugated sheet metal using a laboratory office prototype. Company developed a machine using coil stock, offset through forming dies which fold the metal into corrugated shapes. Machine can handle conventional materials and its simple applications in stock sizes up to 36 in. width. Wider stock would require a larger machine. Company says setup time is short, labor costs for loading and unloading are small and dies have about a 1,000-lb life. Current coils are being made in metal gages ranging from 8.001 to 0.001 in., with tolerances of plus or minus one thousandth.

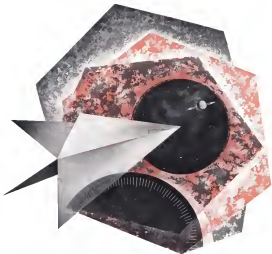
Sylvania Electric Products' Watkins Laboratories has a \$2.4 million contract for development, fabrication and installation of two 60-ft ground antenna stations for U.S. Army Signal Corp.'s portion of the Advanced Research Projects Agency ADVENT (Advanced Very Large Earth-based Network) communications program. Project ADVENT combines research leading to a worldwide communications network that will operate through utilization of "relayman" satellites. In orbiting space 27,000 mi. above the equator in the same direction and at the same speed as the earth's rotation, each satellite would appear to hover over a single ground point.



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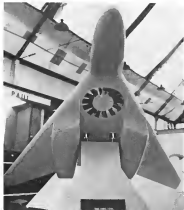
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Boulton Paul Aircraft's concept of a VTOL transport, the P-146, is shown at Farnborough in model form.

Boulton Paul Unveils VTOL Configuration

Model on display at 11st Society of British Aircraft Constructors exhibit at Farnborough shows VTOL transport configuration proposed by Boulton Paul Aircraft, Ltd. Designated the P-146, the study envisions use of a total of 18 diesel jet engines housed in four pods for vertical lift plus three sub-jets—one in the tail, the other two positioned around fuselage forward flight also functions. Two pods, each containing five small diesel jet engines, are swung from inclined pylons jacking from either side of the nose. Remaining two pylons, each with four diesel jets, are located on tips of the swept wings. Boulton Paul Farnborough display also included VTOL wind tunnel model (right) with a single lift jet engine housed in its fuselage section and two tail-jet engines beneath the wings for forward flight.



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WHAT'S NEW

Reports Available

The following reports were sponsored by the Office of Technical Services, United States Department of Commerce, Washington 25, D. C.
Motorola Research in the Navy—Office of Naval Research, March, 1966, Vol. 1 56 pp, 58¢ pp (PB 167473) Vol. II 51 pp, 375¢ pp (PB 161471)

Radical Chemistry and Related Phenomena—L. P. G. W. Wright, USAF, and others, Wright Air Development Center, Muroc Laboratory, Fort 1, II & III, November, 1959 52 25 93 pp (PB 162414)

Investigation of Liquid Nitric Oxide as a Rocket Oxidizer—L. E. Bollinger & R. Edgar, Ohio State University Research Foundation, March, 1959 575, 79 pp (PB 161580)

Appendix to Civil Aeronautics Manual 5-51.33, 254 pp, Order from Superintendent of Documents, Government Printing Office, Washington 25, D. C.

Publications Received:

Diagrams of Automatic Control—Richard J. Biddison—Ronald Publishing Corp., 450 Park Avenue, New York 22, N. Y. 50.00 252 pp. Contains basic concepts and control theory. A detailed index contains a subject breakdown.

Stabilization of Free Radicals at Low Temperatures—U. S. Dept. of Commerce, National Bureau of Standards, Washington 25, D. C. 51.98 116 pp. Review of a three-year program in free radical research initiated at the Bureau in 1956 and terminated in Oct. 1, 1959.

An Introduction to the Theory of Aircraft Structures—D. W. Young—St. Martin's Press, Inc., 375 Fifth Avenue, New York 22, N. Y. 52.50 445 pp. Assumed as a background for the solution of several structural problems.

On Wings of Faith—Violeta Constantino, Kalamazoo-Buffum House, 317 Madison Avenue, New York 22, N. Y. 53.95 244 pp. The story of the first French to fly down the eastern coast of South America and back to the U. S. in the westernmost in a single engine plane.

Video Tape Recording—John Berrutta—John T. Rudy Publishing, Inc., 116 W. 14th Street, N. Y. N. Y. 53.95 272 pp. A fundamental treatment of the techniques, mechanics and the theory which are used.



TODAY...

HAWK makes first missile-to-missile kill

Raytheon HAWK, designed for defense against low flying aircraft, achieved the first known kill of one missile by another on Jan. 25, 1960 at White Sands, New Mexico. Most recently, HAWK achieved an other sensational first by blowing out of the sky a much smaller supersonic missile.

The proved achievements of the HAWK weapons system for defense demonstrate Raytheon's complete systems capability.



TOMORROW...

Advanced aerospace defense systems from Raytheon

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Research and study programs have produced a broad range of advanced defense systems concepts. As with HAWK, Raytheon is applying its proved systems capability to these programs.

RAYTHEON

**MISSILE
SYSTEMS
DIVISION**

Waltham, Massachusetts



At and ground crew of 60 Squadron at Royal Air Force Farnborough demonstrated a scramble of four Avro Vulcan B Mk 2 strategic bombers on the second day of Farnborough. Scrambles of Britain's other two V-bombers (jet-powered Handley Page Victor and Vulcan Vulcano) were conducted on other days. As scramble begins in run (above) aren't have been down to a simulated disposal site also receiving intelligence reports of an impending attack, and the aircraft are at their stations inside the planes.



When the scramble order is received, a ground crew system guides all four Vulcan B Mk 2's (left) engines (above) only, and within 30 sec., the lead aircraft is beginning its rollout and at the second plane moves into position. Last two aren't going into position (below) and prepare for takeoff.



With afterburners lit, Vulcan takes runway and begins to climb (left) over Farnborough. Afterburners still on, Olympus engines and and high smoke trails (right) as Vulcan continues almost vertical climb to altitude.

RAF Crews Scramble Four Vulcans at Farnborough

Defining Vulcan, its crew takes extended, makes high-angle-of attack touchdown onto Farnborough's air-captain runway.



Some Properties of "K" Monel alloy at Low Temperatures

Condition	Temp., °F	Yield Strength, ksi	Tensile Strength, ksi	Elong. in 2 in., %	Reduc- tion of area, %
Quenched, air hardened	Room	130,000	140,000	30.0	33.0
Quenched, air hardened	-110	134,000	141,000	17.0	41.0
Cold-chamber, air hardened	-300	110,000	120,000	20.0	47.0

*Mechanical values

Gets tougher and stronger as temperatures go down

"K" Monel alloy also resists oxidation and corrosive attack

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MANAGEMENT

Digressions Cloud Real Research Goal

Digressions from the main goal of research were discussed recently by Dr. H. Abbott, director of advanced research programs for the National Aeronautics and Space Administration, at a Princeton University seminar on research planning and management. The crux of Abbott's long association with the U.S. research effort and the presence of his views in light of our month-long interest in research, *Aerospace Week* is publishing his discussion of the problem.

To a great extent that can be generally defined, both the quality and quantity of scientific research is dependent on the kind of management it receives. The relationship between quality of research and management is obvious.

High quality in research will, in turn, lead to the confidence on the part of general management, whether governmental or private which is necessary to support the amount of research needed. Good research management can also greatly increase the amount of scientific research by inducing those digressions which merge the time and resources of many scientists who are separately conducting research.

I do not intend to discuss digressions from the desired goal of professional research programs or even digressions from the broader planning aspects of general management. Such digressions are characteristic of research which programs by following up new alternatives and thoughts until the existing pattern may have little resemblance to that planned. The unfolding knowledge produced by research reveals both possibilities and limitations which make it all but our most recent plans seem naive.

Definition of Research

I think of research as the process of seeking new knowledge. I use the word "knowledge" to denote a resolution of understanding and its adequate match with the more possession of its foundation. The knowledge of which I speak is also new in the sense that it is obtained by the research scientist directly from the study of nature in the light of existing knowledge, and not by the process of education.

Much activity that is called research does not qualify as the process of seeking new knowledge. For instance, the research process involves the acquisition of data or the collection of information but such activity does not, in itself,

constitute research. Conversely, all such activity is not included in the research process.

To take an obvious case, no discovery has it said that an article or book is well as good. "Inscribed as the time was, by securing that the author was well or poorly informed about the facts. If the author works as part of a team, the people applying the facts may be called "research assistants" or "researchers." We, who are engaged in scientific research, do not see such use of the word "research" but our enlightenment might be increased and our knowledge strengthened in a clear lack of understanding that scientific digressions from research.

The term "basic research" is a good specific label or even substitutes. The research man, of course, is familiar with both the information and knowledge generated in his field and often both in the work of others. The task given to acquiring this education is.



In H. Abbott, director of advanced research programs for the National Aeronautics and Space Administration, has spent 17 of his 31 years in permanent management and space research. He joined the old National Aeronautics Committee for Aeronautics and Space Administration in 1959 after graduation from Princeton into the Institute of Technology. Abbott moved to NASA headquarters in 1967 and was named assistant director of research for aerodynamics in 1970. When NASA was established Oct. 3, 1958, Abbott became assistant director of research for aerodynamics and flight research. He has held his present position since July, 1970.

encountered to him and to the success of his research. It is important however to recognize that some of the education which must continue as long as the research is active and productive, and to distinguish between that activity and research.

I expect that some of us with experience in research will recognize the existence of individuals who spend their whole lives in the activity of self-education, but who are not so much interested in research. That because research, as frequently recognized in being an understanding competence in their field, but produce neither a new, but of data or a new idea.

A few of these people can be very useful in a research laboratory if they are cooperative. No library, no matter how productive, permanent information on research, and the self-education of human mind. Unfortunately such a person will not necessarily acquire such a reputation for wisdom that he may become responsible for the management of research. Then according to the line of action, he represents his own kind, and research direction or discipline.

Avoiding Digression

The particular digression is probably the least prevalent of those I shall discuss and the easiest to avoid, since the danger is recognized. Invention on research, and the self-education of human mind, is not necessarily a good thing, especially if they are in separate contact with standard words. Research individuals must not be permitted to inventable in the organization, or to have supervisory responsibilities.

The second digression I wish to discuss is much more prevalent and difficult to control. This digression is a consequence of the organization and its organization, sometimes leading, if corrected to complete discontinuance of research. I would like to quote Prof. H. H. H. (in Science Magazine) on this point.

Scientific knowledge grows like a organic tree, not as a compilation of collected's men. Facts, observations, discoveries, as they are, are the subjects on which the tree of knowledge feeds, and not until they have been thoroughly observed and analyzed, have they truly entered the body of knowledge.

Accordingly, if knowledge grows like organisms, we ought to observe sound direction and avoid unhealthy ones.



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staffing the reception of glit-industries, superlatives, overstatements, and just plain bull—are already noticeable in current scientific practices. Part of the modern crisis reflects exaggerated claims, such as "soft science" or "pseudoscience." But the crucial element is a tragic waste which fails to recognize the true character of knowledge. Once set on sight, the tools of research in which data collection should be related no longer guides the search for data. The sense of relevance and selectivity becomes a fog, conception stops at sheer compiling, statistical baroque formulas, and freedom of interpretation degenerates into license for random conclusions.

This is a serious indictment, but I believe that as scholars, impartial just would bring a verdict of guilty to many of our so-called research activities.

I do not wish to deplore experimental work and the gathering of data which provides the foundation for our scientific process. Nor do I wish to devalue this activity in any way. Experimental work frequently involves the highest quality of skills and preparation to produce the information that is required. The experimental work itself, however, is guided by moral scientific thinking to devise the experiments needed to build the theories and understanding that advance knowledge.

I often recognize that the current rapid pace of design and development in some fields demands the accumulation of search data obtained to fulfill preordained goals rather than to serve as an unexamined basis for the advancement of knowledge. Such activities are necessary and proper, and frequently result in progress at a greater pace than would otherwise be the case. But, the value for such data collection should be recognized, and the work devoted to the purpose intended.

There is a point, however, at which the accumulation of data becomes an obstacle, so that in itself that search little useful purpose of any kind. This divergence grows like a fungus on the back and impairs intended lot in search, slowing down current activity but leaving behind only decay and not progress.

This obsession with data accumulation is an attitude of mind which can occur in any laboratory in any scientific field. It is not necessarily associated with any type of race or opposition used in the process. I fear, however, that the American tendency toward this divergence has been encouraged by the availability of very large, costly and complex pieces of research equipment which require teams of specialized people for their operation. This has frequently resulted in organizations geared to the operation of the equipment rather than to the research problem.

These organizations then tend, as



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the American tradition, to become efficient in the operation of the experiment, designing experiment upon experiment with less than adequate consideration of the scientific principles involved, and producing results of data which are not classified, in extreme cases, much of the data may never be published because the frantic effort to produce more data leaves insufficient manpower for the writing of even data reports.

Such a questionnaire was used to mark agreement or dissent for a more scientific approach by making matters even worse through including even the data authors and report writing in production line activities. Once this is accomplished, they will be confident that they have reported adequately and will attempt to sell their methods to other groups.

'Process of Discovery'

Even this may not be the end of the process of discovery. If the research management is not deluded by the increased effectiveness of data production, it may try to correct the situation by considering some of the more scientifically minded individuals in special teams not attached to any research equipment.

Such teams are usually given reports indicating their acceptance in theoretical or analytical research. The equipment operating groups are now deprived of whatever scientific benefits of thinking that they might have retained. The "methodical" groups soon become of getting the experiments they need to guide their work included in the designs and conducted in the manner they desire. Often headed by unusually talented and forceful people, the "methodical" groups tend to deteriorate after their first success, and may turn to the paper and pencil equivalent of data production.

The management problem encountered in conducting such an autonomous research team is not that of persuading its commitment, and more requires drastic steps. The first requirement is, of course, the selection of research personnel who understand the research process in operation at all levels of the organization. The second requirement is to provide an organizational structure that encourages research activities rather than state data production. If it is necessary to experiment, avoid large, complex research facilities; these alternate organizational methods of encouraging a research atmosphere are available. All of these can be made to work well, and the best one to use will depend on details of the particular case.

The last alternative is to integrate strong research leaders into each group organized about its own particular facility, and to assure that the best of each such group is generally research oriented.

This solution works especially well if the character of the research is such as to permit adequate approaches to important research problems to be made with the equipment assigned to each group with extensive programs involving several such groups brought into play for the broader problems.

The second alternative is the opposite of the first. Each group organized about a particular facility provides a service function for the research groups which are assigned in accordance with the research problems to be attacked. This method works well when most of the research problems require experimental work in several facilities to produce the required data. The research personnel, however, must plan the experiments and work in the facilities involved while they are being made if the essential components of the research process is to be maintained. This implies that the back-up operating groups be reduced to the minimum required to provide some backup and to insure proper and safe operation.

The third alternative, which is in many respects the best, looks exactly the same as the first in the conventional organizational diagram. Superimposed on this management organized design, however, is a second, or shadow, organization oriented to the research problems rather than to the equipment. Many of the research experiments were two or more left, reporting along the conventional management lines of authority on most matters, but reporting along the lines of the shadow organization fully open to the direction of the research projects.

Effective Organization

Usually the shadow organization is described as research teams cutting across the usual lines of authority. This alternative is sometimes poorly appreciated by management reports, but when properly organized, directed, and understood by the staff it is a research efficiency.

The third diagram which illustrates the main goal of research is a methodological diagram for management use only. This diagram does not refer to the core which must be taken to research to avoid mistakes and to obtain accurate results. It refers rather to research activities to obtain more and more information under conditions where that accurate data is actually to lead to an new fundamental understanding or to produce information of lasting practical significance.

Let me take one example from an open exposure in the field of aerospace research concerning the problem of solving the geometry and aerodynamic characteristics of high lift devices and controls for supersonic flow in the wings of subsonic aircraft.

Some three wanted to guide this character of the research is such as to permit adequate approaches to important research problems to be made with the equipment assigned to each group with extensive programs involving several such groups brought into play for the broader problems.

Main Problem

The main features of the problem are become apparent, including the best that accurate prediction of the characteristics of air flows required the testing of that exact design under realistic conditions. Designers were anxious with this model and several other wings and some work in the wind, hope that additional research of this type would change the basic situation. The extreme application of research resources to this divided problem was brought to an end and other plans shifted to higher speed aircraft with more difficult problems.

This is a typical example of activities rather than an example of one. Each of the six air flow models, and other examples in direct use field of research.

This example relates to experimental research and accordingly is each contained with no unusual degrees of research data accumulation. The diagram is that data accumulation stops the research process in real time while methodology applies the complete process in real progress.

Methodology is not confined to experimental research, but theory equally well as well-built activities. It tends to think of the number of first drafts that have gone into a highly detailed but capricious effort obtaining higher representation and refining theories has only capability of accepting such results because some misinterpreting used in the original derivation resulted in some context of a higher order than those being considered. I like to think that these same drafts properly directed to take a wider view of the problem would have achieved some noticeable scientific advances.

Methodology sometimes results partly from pressure control by technical experts but probably misleads people. I want the part in the example cited. It results much more frequently, however, from intellectual laziness and from the comfort that results from following a technical rule instead of asking not only how good it frequently happens that

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individuals or teams who have made substantial contributions to knowledge then active efforts concentrate to public their contributions instead of taking on new problems.

Originally, these contributions usually need further work to correct major errors and usually obvious deficiencies. There comes a time when this work is unexciting and new tasks should be undertaken. It is, however, much easier to correct the old work or which the time has become an outstanding achievement than to add both into unfamiliar waters where the risks as well as the opportunities are greater. Unless both old and new frontiers will continue to use the same work again and again through the repetition in the hope of finding another drop of error and soft even field bigger and better spheres for the job.

Correcting Meticulously

The correction of meticulous is one of the most frustrating but most important duties of every scientist during his lifetime. He cannot always point to the fact that this research is being conducted in a non-scientific manner. The individuals involved in virtually every field of science show themselves, point to the more details which are almost left unattended, and ask positively whether the director is unconcerned in the scientific pursuit of knowledge. The best way to correct the situation is, of course, to tell the people interested in broader, more important problems. This is not easy but should be pursued diligently.

If not successful, the next step should be to chip away at the trend by the gradual transfer of the manager more powerful members to other teams where they will have the opportunity for exposing their behavior. In the time the trend is reduced to a minimum it may be either abolished completely or left to pursue its course in a small way if the work warrants such activity. Only one sure method is to use the individual a large active team all at once, because such action is too easily misunderstood in evidence of an unscientific attitude toward science.

The fourth disposition I wish to discuss is habitual repetition, the practice of repeating in speeches but following reasoning in good faith and without recognition of its nature. This repetition is not merely boring, of importance is also perfectly avoided society although it has not been an leaves, therefore to the history of science.

Fortunately, one expects to explain to the present sometimes tell by scientific organizations to produce practical results faster than conventional will permit. This leads to the temptation to reiterate or discuss without

recessive information to guide the work. If the results are well received by a scientific, more management, the process continues.

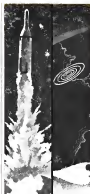
In the actual course of events, the process becomes habitual, and the results are well received in other so-called scientific research in similar manner at other organizations. The position then becomes endorsed by a segment of the scientific community itself, and self-perpetuating. Every new idea or knowledge does not stop this activity, because in the time such data are obtained the individuals involved are no longer directly concerned because they are concerned further with new, as known ones. Thus, the individuals in organizations involved are more anxious for their persons evidence because this was among the processes, and if their results are fairly good, they stop, this is not what they frequently the case in science. Thus, the readily successful science may be built on a consistent succession of historical, unexciting data in a knowledge of the scientific process of generating hypotheses on the basis of existing knowledge and observations which are then checked by properly directed experiments, and discarded as necessary, and finally accepted as knowledge. In scientific hypotheses appear as combinations to serve as the basis for more scientific, and ultimately tend to replace evidence as it from a true position.

Continuous Digestion

Two factors in the management are central for the continuation of this disposition. The first is long delay in making experimental checks of the so-called conclusions. The second is public without waiting in public. Thus, scientists become in demand in such a way, and in order and space to society. The examples I refer to to read daily newspaper. Almost no criticism will suffice.

The danger is not much that the digressions continues on the slender resources available to research. It is because, in contrast, one is preoccupied to reveal that those who adhere to the discipline of research are in danger of being charged with lack of vision in the contemporary and intellectual picture of science becomes more definitely engaged in the public mind. Some of our largest research-developing agencies are making a virtue of projects that have been refused support by more scientifically minded groups.

It is claimed that in science, one must take a chance. Nothing is over in the sense that one does not know what of practical value will result from fundamental research. The closer we peer, however, a Monte Carlo approach to the study of science that is to



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direct challenge to the scientific process that has been developed in the last few centuries. Scientific efforts are in a danger of becoming disintegrated. Then, indeed, in the words of Wain, will "hundreds of separate rate become for random movement."

In the area it is no effort, research management needs wisdom to distinguish between the doing and probing and the frequent artistic planning but requires wisdom of the highest. Research management must have the courage to oppose this artistic instability, to find all whatever processes may be encountered from whatever quarters, and to reduce to a minimum the type of problems that ensue from it.

Fifth Digression

We come now to the fifth and last digression I wish to discuss, that of design and development activities. This is in many respects the most serious one, and the most difficult for management to solve.

Let me say now that I do not believe that the large, extensive research activities so characteristic of our time are being conducted in any loose, separated and isolated from the practical realities of life. Perhaps some of our researchers do need this closely, just as some plant people need the shelter of a greenhouse. The vigorous forest, however, grows outside, subject to all the heat, cold, and tragedy of the natural environment. The same is true for research. For the most part, research facilities are as an integral part of life, subject to all the struggles as well as the suffering, competition, and harassment that this implies.

Neither do I believe that science, including basic research, needs to be detached from the impact of practical needs. Nuclear physics did not suddenly become defined and unproductive when nuclear power was produced, or when some of the most explosive human tragedies occurred. The most significant research needs made fluid boundaries are less important to the scientific mind. Research needs extreme control and firm boundaries when the research is put in putting research knowledge to practical use.

Here we have the problem. How is this attitude toward life to be achieved without resulting in practical applications crowding the research out completely or changing its character to a purely supporting role that cannot be productive of new ideas? Research is placed in much the same position as the pilot fish which is traditionally reported to push the shark, and is almost subject to accidental destruction in its helpfulness. It must be open to such its weakness from the jaws of the shark.



JetStar Interior for Checking Navoids

Model of Lockheed JetStar jet engine at jet, of which has been collected by U.S. Air Force has been checked at various and maintenance facilities (AW) June 27, p. 10, shows engine, which is shown in various and Air Force. Service engine's engine, with various status of its right. Equipment used are shown and shown. Aircraft has been designed C-40.

without actually being outflowed. Many people believe that the research activity should be integrated into the organizations seeking to apply research knowledge. In the physical sciences, there are the design and development organizations.

Research Integration

The integration means close coordination of research and development. In the words of those who do not understand the distinctions involved, it also provides the research scientists with opportunities to carry their ideas through the complete process to the end product.

I know of at least one case where this integration has occurred while both the quantity and quality of the research has not suffered. In the first place, the demands made by development release the resources left for research. Whenever there is a conflict between development and research, the development side, the demands made by development release the resources left for research. Whenever there is a conflict between development and research, the development side, the demands made by development release the resources left for research. Whenever there is a conflict between development and research, the development side, the demands made by development release the resources left for research.

The recognition of this fact, the development side, the demands made by development release the resources left for research. Whenever there is a conflict between development and research, the development side, the demands made by development release the resources left for research.

through" occurs, the exploration of which requires both process and development activities. Examples in the last 20 years or so include rockets, the nuclear bomb, nuclear power, and radar. Each of you can no doubt name others.

At such times, it frequently becomes apparent to management that no existing organization that can be turned from its current work is really well equipped to exploit the new knowledge, and one or more new organizations are created for the purpose. This recognition of the deficiencies of many existing organizations is central to its logical conclusion: new entities that they are also usually, and well suited to exploit the new knowledge, new knowledge, new knowledge being produced by research.

Now, let us examine the typical characteristics and history of such a new organization. It is started with a well selected staff composed of brilliant research scientists and confident design and development men. It is given all required support. The research is of the highest caliber and the information produced is studied and applied immediately to the development of the new product. Unfortunately, difficulties encountered in development immediately spark new research activities which scientists tend to accept without reservation. In short, the new organization is a great success and proceeds on short order to produce the product and then for which it was started.

Then the picture begins to change. The new team needs various support.

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Accurately measures and controls the amount of fuel delivered to the missile tanks. Original specifications called for a metering accuracy of $\pm 0.05\%$. Extensive tests, conducted by government test equipment, show that the system is capable of metering and delivering missile propellants with far superior accuracy—to $\pm 0.1\%$.

Automatically compensates for factors influencing fueling accuracy. The fuel is continuously sampled and the flow corrected for variations in temperature and density. In addition, the fuel which vaporizes in the missile tanks is returned to the system, condensed, measured, and an equivalent amount added by the metering unit.

Adaptable to many different missile fuels. The system is designed to handle such storable liquid propellants as hydrazine, nitrogen tetroxide, Densase® (UDMH) and others.

Economical to manufacture and safe to operate. To reduce development, manufacturing and operating costs, the system makes maximum use of standard, interchangeable, and commercially available components. The simple and safe design eliminates human errors and danger to operating personnel.

Mobile and compact. All metering, pumping and control equipment is mounted on a single, portable trailer. The complete unit may be easily transported, rapidly positioned, and provides a single station for the monitoring of fueling operations.

The successful development of this mobile metering and handling system by the engineering staff of FMC's Ordnance Division is another achievement made possible by utilizing the unique capabilities of chemical and mechanical engineering talent available at Food Machinery and Chemical Corporation.

Metallurgical Memo from General Electric

G-E Vacuum-Melted Alloys Now Conquer Wide-Gap Brazing Barriers



Wide gap brazing alloy is applied to turbine nozzle assembly. Nozzles are lock-welded in position prior to brazing.

New G-E Wide-Gap Brazing Alloys offer:

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Looking for new methods of fabricating high-temperature turbine? Nothing can equal G-E vacuum-melted brazing alloy procedure for critical applications. All provide the elements in reactive element control and extreme cleanliness which are vital to alloy casting success.

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Get all the facts about G-E vacuum-melted brazing alloys as a short-cut to lower cost manufacturing methods. Write: Metallurgical Products Department of General Electric Company, 1120 N. E. 8 Mile Road, Detroit 25, Michigan.

METALLURGICAL PRODUCTS DEPARTMENT

GENERAL ELECTRIC



Inset shows nozzle completely brazed in spite of gaps. Shown around perimeter of nozzle are from shop floor.

ments, and new models are developed. The organization has become large and expensive, and management wants the minimum of waste for its money. The management is involved most at several times, and the lines of control are tightened. The research becomes more closely controlled and directed to meet definitive ends. Some of the better research staff drift away. Others see when the goals grow greater and become definitely identified with design and development. The process may take only a very few years or a generation. Finally the organization becomes a somewhat study development group incapable of producing and starting the career and interest in accepting or exploiting those created elsewhere. We then complete the cycle by setting up another new organization.

I have pictured these combined research, design, and development organizations as having a type of life cycle, what might be a living organism. They are born as a vigorous youth, rapidly reach an early productive adulthood, and drift into middle age, decline, and death. What is wrong with this? It is certainly an end of life and has been used effectively not only in this country but throughout the western world.

The question is, "Is this process good enough?" My brief description of the process has revealed two aspects of the problem. The first is the dislocation resulting from the control of work and organization. The second is the loss of people trained scientists. To the extent that these scientists return to their work as the new organization approaches middle age, this is an overall loss.

Important Loss

Unfortunately, many more return to science but are handicapped by better pay, more immediate and definite recognition, and other factors into design and development work. Sometimes mislabeled research, where they can be other very capable or very poorly qualified. These lost scientists represent a drain on our training facilities which I do not believe we can long sustain.

The second aspect is that these organizations usually do not complete their cycle by dying, at least not at any reasonable age. They stay with us, living partly as their glorious past and partly on the merits and problems associated with designing and engineering. They continue to produce new products of about a scientific nature and do it inefficiently and with a conservatism



AirResearch Converts Convair 540 for Napier

AirResearch Division of Grumman Corp. has completed turboprop conversion of first of two Convair 540s that D. Napier & Son, Ltd., will deliver to Airship Airways.

that is a drag on both progress and the general economy.

The alternative, I believe, is the research-oriented research organization operating to a high level in the overall management structure of the company or government. Many of our best industrial research organizations report directly to the president of the company or to some other highly placed official. In government, the National Advisory Committee for Aeronautics was a unique but obsolete placed agency whose sole mission was research and which, as an independent agency, reported directly to the President. The National Science Foundation, today, is in a similar position.

Management's Responsibility

The success of this organizational structure will depend upon the quality and vision of the research management. If the research scientists are protected too well from practical problems, they will tend to become too academic in point of view, will fail to meet the expectations of general management and will lose the support. If they are too responsive to the day-to-day problems of development, they will soon go the next way in through integration into the development work. The task is to maintain aloft the development problems and response to such needs without becoming subservient.

The project research organization must feel full responsibility for solving certain that the problems of today, tomorrow, and 10 years from now are identified, that research is started in a timely manner and conducted with a view to find solutions that are at least acceptable.

It must accept some special responsibilities

arising from development problems while retaining its right to reject ideas that it considers of less importance or capable of solution by other known methods. It must maintain the closest possible contact with development, providing consulting services, lead, in action, becoming intimately familiar with the obstacles being encountered or foreseen. It must provide technical guidance to the plant for future developments through the knowledge provided by a broadly based research program, including basic research, without undue restriction by the relative overall plans of general management.

The research community, therefore, must take the initiative in establishing these broad responsibilities with the development engineers. This initiative is not, in itself, enough, however. It requires responsiveness and ability to help they must create an atmosphere in which the development people will actively seek their assistance. Such a research organization can maintain its productivity and enjoy leadership.

'Invisible Dangers'

I have identified five dangers from the main goal of research as shown which, I believe, represent the greatest dangers to the future of research in this country. They are: 1. Inadequate design, especially because those of them represent activities that are expected and demand in materials and which must be understood in some degree as all research establishments. The others represent provisions of the research process itself.

The danger lies in thinking these dangers are minor in permitting them, usually to use the similar in activities intended for research, and in the consequent possible differentiation

of management and the public in the research process itself.

The solution must depend on the willingness of research scientists themselves to accept the responsibilities of research management. The research process is a complicated one and has developed its own management techniques which differ from the more usual ones in being less on functions and more on continuing technical discussions.

Selecting Managers

I believe that research should be managed by people who understand the research process, i.e., research scientists who have made substantial contributions. If such people are unwilling in sufficient numbers to forgo their preferred individual work to make it possible for other scientists to work under proper conditions, research will continue to suffer. Scientists of ability who wish to participate in research management have little right to complain about the quality of the management under which they work.

Only research scientists of proven ability can be expected to have the insight to identify the discrepancies I have discussed from the normal healthy activity of research. Only those who themselves have conducted research will have the sensitivity to the research climate to correct such discrepancies firmly but with a touch tactfully and soft to promote proper working con-

ditions. In this sense, I should like to close by quoting an excerpt from a letter written by Oliver E. Backus, then president of the Bell Telephone Laboratories, to the New York Times and published on Aug. 25, 1949:

"One sure way to defeat the scientific spirit is to attempt to direct inquiry from above. All successful in directed research direction knows this and have learned by experience that one thing a director of research must never do is to direct directly, nor can he permit direction of research by any superior board.

Successful research goes to the direction in which some inspiring need finds itself unmet. Thus, goals are set, goals of fundamental research, and goals of practical accomplishment in the case of applied research. Tenacious research effectiveness is often lost and the director of research does his part in building teams and seeing that they are supplied with facilities and given free rein to pursue their inquiry. He also seesers for their creative material to their work but at the same time protects them from interference or diversion arising from demands of nonresearch operating needs. He assigns fields of research and broad objectives to the different groups working under his direction, but he must depend largely on those doing the work to find the gaps in knowledge and the opportunities for practical improvements."



British Vigilant Designed for Paratroops

Vigilant anti-aircrafting was pulled into existence, weighs 45 lb. The British weapon is hatched from its container and is guided by hand-held light. Range can be varied from close to about one mile. An antiaircraft or paratrooper can operate the machine after five hours of antiaircraft training and three to five days Vigilant use. The British War Office has ordered 200-500 Vigilants for delivery trials (AW Sept. 5, p. 54). Production version of the Vigilant is expected to cost about \$900 a unit.



MOTOROLA Military Electronics Division



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DOWN-TO-EARTH cost orientation at Motorola begins with disciplined research applied to creative ideas and, progressively, permeates every stage of development, assembly, and final production. Ultimately it is reflected in lower field maintenance and support costs commensurate with the desired level of reliable performance. This acute awareness of total cost versus initial cost, sharpened by more than thirty years of competitive experience and commercial success, is characteristic of Motorola's complete military electronics capability in terms of systems, equipment, and solid state components.

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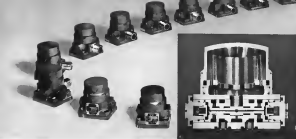
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More detailed information is available in a comprehensive brochure.

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◀ KEARFOOT: "... better machining... faster running time..."

The all titanium 4000 class submersible valve valve made by Kearfoot-Denson, General Precision, Inc., is designed for an Army provided ground missile. According to Kearfoot, the device is an inductor (T-6A1-4V) was based on an analysis program that generated the following design features:

- **Weight reduction** "Use of titanium in place of stainless steel in all structural members of the valve results in a weight reduction of 28% (48 lbs.)."
- **High strength-to-weight ratio** "Use of titanium in place of aluminum and stainless steel results in a smaller valve, without sacrificing the rugged construction essential to high pressure hydraulic components."

• **Low thermal coefficient of expansion** "Use of titanium eliminates the danger of loosening shrink fit in elevated temperatures that would occur if stainless steel or aluminum parts were employed."

• **Corrosion resistance** "Use of titanium provides corrosion resistance equal to or better than stainless steel."

• **Machinability** "Because titanium is highly machinable, valve production is easily maintained. For most machining operations, titanium shows better performance than type 316 stainless steel. By utilizing high-powered machine tools at the proper speeds, faster running time was achieved."

WOLSKEL: "... hundreds of thousands of titanium fasteners per month..."

The welded fit of the SAC is virtually held together by titanium fasteners... at tremendous savings in airframe weight. An estimated 100,000 titanium fasteners have replaced steel in the B-52G and in the "Blondie" B-57H. The weight-saving is approximately 100 pounds per airframe.

Titanium grade Ti-6Al-4V, used in most of the B-52 titanium fasteners is 40% lighter than steel and is heat-treatable to a tensile strength of 160,000 psi. In addition, it has superior fatigue resistance and atmospheric corrosion resistance.

"... easily maintaining tolerances... of 0.0005"

Wolfschlag Manufacturing Company, Culver City, California, fabricates from titanium three major propeller fastener types used in the B-52... H-3500 rivets, Lockbolts, Hi-Torque bolts, as well as standard hex bolts.

Here is what Wolfschlag reports. According to Mr. Tom Harker, Chief Mfg. Engineer, "Titanium's ease of machining and other fabrication characteristics have enabled us to produce hundreds of thousands of titanium fasteners per month. Quality is high, too. For example, we are easily maintaining tolerances on bolt tolerances of 0.0005 in. We call it a matter of proper technique."

RAYTHEON: "... helped us overcome... turbine wheel distortion..."

Raytheon Company, prime contractor for the Army's Hawk Missile System, selected from steel to titanium grade Ti-6Al-4V in the manufacture of its turbine wheel which carries the missile's directed power and Operated at 24,000 rpm at temperatures up to 1500°F, turbine wheel performance was previously hampered by deflection problems.

Ned Connor, Product Engineer, says, "Titanium's combination of light weight, high tensile strength and dimensional stability at high temperatures, gives to the turbine wheel distortion caused by buildup of high centrifugal forces during operation."

SCHLITZ-THRU: "... able to reduce our machining given appreciably..."

Schlitz-Thru Corporation, Dayton, Connecticut, vehicle producers of turbine wheels such as the Raytheon Hawk missile test shows, reports a preference for titanium from a manufacturing standpoint.

Vice President E. F. Schlitz says, "Since Raytheon changed from stainless steel to titanium for its turbine wheel we have been able to reduce our machining cost appreciably while maintaining tolerances to 0.0005 in. and meeting delivery schedules."

How **Titanium** opens the door to High-Volume Markets for Precision Parts...

THE KEY: ease of machining coupled with light weight and performance!

More and more component parts manufacturers are discovering that titanium clears the way to new profit sources. By substituting titanium for heavier materials, their components are performing better... are lighter in weight, more compact and stronger, better able to withstand corrosion, to resist deflection and dimensional loss at high temperatures.

And best of all they are finding that they are able to machine titanium parts in volume... to great precision... with the same equipment and with short lead times. In other words, *production at a profit!*

EASE OF MACHINING...... THE KEY: Fabricators who have worked with titanium have found that it will machine as freely as well as the stainless steels, with little modification in equipment.

Titanium doesn't work harder to cut in the austenitic stainless steels, copper and alpha bronzes. It has a low coefficient of friction, requires less clamping force and is less prone to work hardening. As a result, low horsepower EDM machines can be described. The necessary techniques - low cutting speeds, high feed rates, copious coolant, sharp tooling, rigid equipment, high speed tools - are described in detail in TIMET's technical brochure "Titanium Machining Techniques." Write for your copy.

For technical information on titanium or for referral to component fabricators of titanium components, call us at the Technical Service Department of Titanium Metals Corporation of America, or the TIMET sales office in the city nearest you.



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BUSINESS FLYING

Helicopter Triples Missile Site Coverage

PH. Work, Tex.—A major construction contractor is the USAF's strategic missile base program is helping the daily operations capacity of its personnel through full-time use of its company's own helicopters.

Western Contracting Corp., Sioux City, Iowa, experiences with its fleet, plus 100-2000 helicopter for its base is feasible that it actually produced a low-price 4000 Ranges to provide even greater flexibility and speed for management and supervision in using that work on the 12 underground hard-core Corral. After several studies it is looking under a \$27 million contract from the U.S. Corps of Engineers to start on schedule.

Western's experience is significant in that it indicates how, when using on-site work, a total site is a critical defense site, aspects of which are under fire from military, government and civilian entities because of delays, particularly in base construction and activation. How many helicopters are it made being used by other contractors thereon or as a charter basis is unknown, but there is a strong probability that a good-sized market exists for extended use of their aircraft in this area, with requirements based to grow over the next five years. After and other sites alone represent a tremendous construction task and the advent of Minutemen, which is planned for more cases, increases the number of accidents that the first-generation types, indicates a strong future for increased use of rotary wing aircraft in supporting this construction work load.

Site Patrol

Industry sources also believe that once the site use completed, helicopter utilization should continue at a high rate because of the need for monitoring the disposed and isolated sites and providing speed, transportation for critical equipment to correct deficiencies of aircraft on station.

Some firms believe that some aspects of site maintenance may be restricted by the Air Force to reduce operations. Since these firms are not military, military, the helicopter's inherent VTOL characteristics, allowing them to get in and out of the site, appear to make it particularly attractive for its long-term mission.

Western Contracting's experience to date highlights helicopter's effectiveness in providing such critical base transpor-



PHOT 101 Keller works a missile part for delivery to one of 12 sites. System also uses helicopter drops in construction. Below helicopter serves at site.



ation is support of a missile site program. The down side underground launching site is its responsibility for the base's safety, and a confirmed flow of things, and other complications requiring direct daily shuttling of work personnel and equipment schedules are brought to the

management personnel over the site, with construction at all the other going on simultaneously, and a confirmed flow of things, and other complications requiring direct daily shuttling of work personnel and equipment schedules are brought to the



Orbits through space

The space-like paths diagrammed above represent a closed elliptical orbit, a parabolic orbit, and, on the outside, an open, hyperbolic orbit characteristic of the start of an interplanetary flight.

Overall flight mechanics is one of the many areas of advanced investigation at Boeing. The staff of the Boeing Scientific Research Laboratories, for example, carries out basic research in such fields as energy conversion, hypersonic, magnetohydrodynamic and plasma thrust.

Other Boeing scientists and engineers are working toward the advancement of supersonic flight, propulsion systems, gas turbine engines, commercial and military aircraft, vertical and short take-off and landing aircraft.

Professional-Level Openings

The wide scope of Boeing programs in all areas of manned and unmanned flight, from theoretical research to advanced precision fabrication, offers careers of unusual interest to professional specialists in engineering and scientific fields, as well as in liberal arts engineering areas. Drop a note, mentioning degree and major, to Mr. John C. Swaden, Boeing Aircraft Company, P.O. Box 36020, 45th Avenue St., Tukwila, WA 98163.

SAFETY

CAB Accident Investigation Report:

Lack of Pilot Vigilance Blamed In F-84F, Piper PA-22 Collision

On Nov. 7, 1979 at 1405 EST, a Ryan P-47L, N 98002D, and an Orion Air National Guard P-51F 519140 collided in the air about 7 mi. south-southeast of the

Minneapolis Municipal Airport. Minneapolis, Minn. The two pilots of the P421 returned first witness. The pilot of the P544 bailed from his aircraft and parachuted to the ground unharmed. Both aircraft were totally destroyed.

The FBI was the No. 8 agency in

Flight of four jets ending in low-altitude pass at 4000 ft. formation across the Wainfield airport from north to south. The F-4's were on a consecutive flight

from Akron to Mansfield and across the day. At the time of the collision it was raining. Mansfield reported snow preceding it a westerly wind direction. The pilot of the PA-12 did not contact the Mansfield tower. The tower controllers cleared the jets for the low pass after scanning the skies over the possible conflicting traffic but failed to see the PA-12. Weather conditions were good and visibility was approximately 10 miles.

Under the circumstances, present or specified for aircraft separation used with the plan of each aircraft. The tower

spenders did not have a responsibility to make certain there was no confining buffer before closing the pit light. It is clear that some of the personnel involved was exercising the proper degree of vigilance although there was adequate opportunity to do so.

As a result of this accident, the board has recommended to the administrator of the Federal Aviation Agency that all instrument lights except those installed on aircraft in current low approach and using no instrument aircraft be prohibited in control zones and/or in the vicinity of post-structural airports. It has also been recommended that all aircraft that are equipped with such be required to notify the appropriate communication facility when operating in a control zone.

Investigation

N 562ND was being operated under a lease-purchase agreement for Shadow Vee was Inc. of Akron, Ohio. The flight of Nov. 7 was for the purpose of giving other country flight training to Mr. Chid A. Farina, a student pilot. The flight instructor was Mr. Arthur L. Stanley, an employee of Shadow Vee Inc. The flight was planned to be from Akron to Mansfield and return. It was to be conducted according to VFR (visual flight rules) and use the

*These are English Standard based on the 14th month; altitudes are above sea level. source: weather data taken are from 1980-1981

plus one Red V (60%) depicted Males about 1947 and no other contacts were made with Mr. CONNOR during last December.

Private 1st Class, USMC, was on Okinawa National Guard company at Ichigo at the time he was killed in the 1945 Tarawa Pacific Campaign, Wakefield, Ohio. The company was led by First Lieut. John A. Wilson who was one of a four-man formation known as the "Wolf Pack."

The two-day formation led by Capt. Steven E. Lewis departed the Memphis airport about 1912 on a local VFR flight. In accordance with an Air Force training syllabus it was to perform various formation tasks and training at high altitude, followed by a formation at point-to-base and scattered (unplanned) releases.

After the high altitude portion of the training was completed a descent was made to close shore formations. Cloud coverage in the area made it impossible to conduct a practice of penetration and evasion. VF-10 Capt. Lewis made the descent as a series of scattered clouds approximately 15 mi. northwest of the target. Capt. Lewis then led the flight underneath the nearest bank in the 6-30.

Over 10 mi. northwest of the field Capt. Lewis called the Mansfield tower to request permission to make a low approach across the field with the formation and the requested landing instructions. Capt. Lewis

stated the primary reason for making the line approach was for the benefit of the pilot flying the No. 7 position, Capt. Noel D. Fischer, who was being regarded as the F-54E. Capt. Lane said the line approach was assigned as a part of the instrument training and that you was to give Capt. Fischer experience in flying close formation at low speed.

Cape Leno said that after permission for the post was received he descended to 1,800 ft. When the light was about 5 m from the field he called the tower once; there were grays, his position and altitude and again was cleared for the approach. He and he took the formation from the field at 1,600 ft. (1,800 ft above field elevation), and on the 778 deg. heading and at a speed of 180 kt.

Southern Boundary

After proving the northern boundary of the suspect Capt. Leroy said he started a gentle climb and felt them to cross an area of isolated visibility near the east of Mass. 800. About this time he No. 2 was who was flying on the left, called him and said the No. 4 was had had a collision. No other members of the flight saw the other aircraft at any time. According to Capt. Leroy, the flight was then at an altitude of 2,000 ft., indicating 150 kt. and on a left bank of about 30 deg.

Capt. Lewis said that in a formation fight the leader is responsible for maintaining

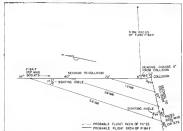


DIAGRAM shows probable light paths of Figs. FA-22 and F-44F which collided at about 2,800 ft. south of Mansfield Municipal Airport, Ohio, fatally injuring both FA-22 pilot.

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gross amount outside its bid of approximately 5,100 drag hours of which about 500 were in the F-4F. Capt. Lewis held no influence over the F-4F.

First Lt. John A. Walker, age 38, was a member of the 144th Tactical Fighter Squadron and was assigned as a pilot. Lt. Walker possessed a commercial pilot certificate with single-engine land and multi-engine ratings. He also had a military rating as pilot. Lt. Walker had a total of approximately 700 drag hours, of which about 250 were in the F-4F.

The Aircraft

PA-12, N 9609D, was operated by Stutz Aviation, Inc., on a time purchase agreement. It had been maintained as an airworthy condition in accordance with factory recommended procedures. The aircraft was equipped with VHF radio and all appropriate equipment.

F-4F, 577500, was assigned to the 144th Tactical Fighter Squadron, 17th Wing, of the Ohio Air National Guard. The wing tactical mission requires that not equipped be maintained in a combat state status and, accordingly, the aircraft was in an airworthy condition.

Pilot Blamed in Crash Of Reeve Airways C-54

Washington-Civil Aeronautics Board has determined that the fatal crash of a Reeve Airways Douglas C-54 probably was caused by the pilot's failure to observe visual flight rules over hazardous terrain.

Congress flight records indicated that the pilot, Capt. Eugene G. Stinson, 40, was evidence a nonstandard pilot's check.

These records also indicated that Stinson, chief pilot for Reeve, had taken all of the physical examinations prescribed at intervals within the air force system by the Federal Aviation Agency.

But CAA investigators declared that Stinson's test physical was taken on Mar. 26, 1956 and that the system, according to a local optometrist and the Eye Research Foundation of Baltimore, Md., was suffering from glaucoma as well as cataracts from diabetes.

The Reeve transport crashed Sept. 24, 1959.

Although the extent Stinson was affected by these ailments could not be determined without an autopsy, which was impossible, CAA reports that the two conditions could produce total or partial corneal opacity, and disturbance of vision, judgment and reasoning in varying degrees.

Stinson's flight was en route to Adak, Alaska, from California when it struck the rugged side of Crater Volcano Island at the 1,000-ft level. Although a 1,500-ft ceiling surrounded the island, Stinson had circled the island for a few minutes before the catastrophic loss of impact. All 16 persons aboard were killed.



Boeing Contracts for Navy Hydrofoil Patrol Craft

Airbus contract shows 115,000, 135A hydrofoil patrol craft to be built by Boeing Airplane Co. for anti-submarine operations under a \$2,000,000 Navy contract. Submarine will lift out of the water with the power from its two 3,000 hp gas turbine engines until the hull is free, then drive at 45 kt or more, borne only by its hydrofoils in the water. Design can templates requires up to 250 no offshore Boeing was contract in competition with El other companies.

AVIATION WEEK, September 23, 1960

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... Mr. E. D. Eiken, Manager, Ground Support Equipment Department, NA 2-1621. Or write for Brochure.



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"Good planning is providing valuable and confident insight into the future requirements of advertising and its companion marketing functions. When projected in relation to a company's growth program, using a current advertising program and budget is inadequate for the next 5 to 10 years. By the planning process you can optimize advertising's future role in marketing—and establish the major contribution that sound advertising can offer in capitalizing on the new markets, new sales techniques and new management practices of the 1960's."



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Shaping the future -

Lockheed's Program Diversification

We are in an era when methods, materials and machines must meet the complex systems characteristic of tomorrow's weapons vehicles. Lockheed's diversification extends from space and atmospheric vehicles to studies of dangers lurking at ocean depths—and how to protect against them.

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REENTRY STUDIES pertaining to landing extended space vehicles from orbit or edge of space glide path.

INFRARED STUDIES for advanced systems and subsystems for missile and aircraft detecting, tracking, imaging, and eventually surveillance.

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SCIENTISTS AND ENGINEERS of outstanding ability are invited to investigate opportunities offered by a company that always looks far into the future. Openings are available in: Electronics systems, automatic controls, servomechanisms, systems research, electronics research, physics—photoacoustic, solar, infrared, flight test instrumentation.

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LOCKHEED

CALIFORNIA DIVISION



WHO'S WHERE

(Continued from page 21)

Honors and Elections

The U.S. Air Force's Cosmic Division of Goddard Space Corp. and Space Technology Laboratories, Inc., have been named to the National Science Association as the vice winners of the Collier Trophy for developing, testing, producing and putting into operation the Air Force's first intercontinental ballistic missile.

Dr. Ralph E. Rusk, deputy administrator of the National Aeronautics and Space Administration, has been named recipient of an Ellsworth Medal by The Franklin Institute for his many scientific and practical contributions to the design and development of the world's first automatic radar homing guided missile.

John C. Dabbs, chief assistant manager of tests for Delta Air Lines, elected chairman of the Air Traffic Traffic Committee of the Air Traffic Conference, a division of the Air Transport Association of America, Washington, D.C., and R.D. Mahan, director of tests for National Airlines, vice chairman of the committee.

The Supreme Tunnel Association has announced the election of the following as officers for 1960: Chairman—Alan Pope, head of the Acropolis Tunnel Department of

Smith Corp., Greenwich, Conn.—Robert E. Carey, executive chair, Wing Tunnel and Environmental Facilities, Inc., Proprietary Laboratories, Roseland, N.J.—K. O'Riordan, head, High Speed Tunnel, National Aeronautics Establishment, Canada.

Changes

Dr. Lawrence F. Jones, chief design engineering department head, Air Mail Corp., North Haven, Conn., Conn.

James R. Rowe, Washington (D.C.) engineering operations, for Aero-Engineering Corp., Springfield, Mass.

High III, director of European operations for Republic Aviation Corp., Farmingdale, N.Y.

J. Norman Brown, director, Solid Propellant Division, Morton Research Corp., Alton, Ill., Ill.

John R. Bell, Eastern managerial system, R. T. Goodrich, Western Products Division, with headquarters at Washington, D.C.

Dr. John W. Collins and Dr. John E. Hahn, vice, basic research, division of Westinghouse Electric Corp.'s Research Laboratories, Pittsburgh, Pa.

John M. Phipps, director of marketing Electronics Corp., Los Angeles, Calif.

Frank E. McKelvey, chief director general of Electronics and Space Technology, Thompson Ramo Wooldridge, Inc., Canoga Park, Calif.

His name was among engineering and

special and programing. General Support Division, American Electronics Inc., 20 Main St., New York, N.Y. John R. Collins, second vice president of engineering.

John N. Sherrill, general superintendent of the newly created New Providence Division, Harbortronics Corp., New York, N.Y.

J. S. Weller, director of the newly established Special Projects Division, Project for Data Systems, The Massachusetts Corp., New York, N.Y.

Alvin B. Y. Moore, director, Propulsion Division and M. F. McCandless, director, Propulsion Division, Deere, Inc., Moline, Ill., Ill.

Miss Elmore, chief modification engineer, L. B. Smith Aircraft Corp., Miami, Fla.

Thomas E. Davis, manager of the newly created, Delta Data and Service Division, Delta Data Products Co., Redwood City, Calif.

James L. Finkler, manager, marketing services, Delta Data Products Co., Redwood City, Calif.

Dr. George J. Martin, chief of development, Delta Data and Service Division, Delta Data Products Co., Redwood City, Calif.

Dr. George J. Martin, chief of development, Delta Data and Service Division, Delta Data Products Co., Redwood City, Calif.

Thomas T. Walters, director of Long range planning, Delta Data and Service Division, Delta Data Products Co., Redwood City, Calif.

John T. Hahn, director of marketing, Delta Data and Service Division, Delta Data Products Co., Redwood City, Calif.

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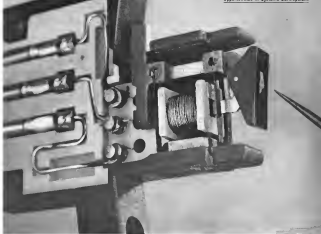
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AVIATION WEEK, September 18, 1960



approximately 5 tons, about 100,000 psi, this new read-write head features air bearing, mechanical RL, and integrated servo drives.

Floating facts out of computer memory



This is a read-write head with an integrated drive. It was developed by IBM scientists and engineers for greater reliability of computer memories. It represents a significant improvement over previous magnetic heads because it incorporates three crucial engineering achievements:

- An air bearing maintains the critical clearance between head and recording surface—even under severe thermal and vibrational environments.

- A newly developed mechanical lift separates the head from the rotating drums, except during actual read or write operation. This eliminates start-and-stop wear.

- Zeroer drives are packaged in the upper section of the head. This integration saves weight and space and enhances reliability.

Work on even more advanced read-write heads is now under way at IBM—around

an developing storage drums and discs with expanded memory capabilities. Interesting assignments are open. In addition, opportunities exist in projects involving, for example, servo-actuators, circuitry, optics, semiconductor, inertial guidance, and human factors engineering.

If you have experience in any of these fields—plus a degree in engineering, mathematics or one of the sciences—you may find the career you've been looking for in IBM memory development. For more information, write—outlining your background and interests—to: Manager of Technical Employment, IBM Corporation, Dept. 3441U, 300 Madison Avenue, New York 23, N.Y.

IBM

INTERNATIONAL BUSINESS MACHINES CORPORATION

LETTERS

Space Communications

You continued as Assistant Vice President, a position you held for 10 years. You were AT&T's first director of public relations. How did you develop your reputation as a public relations expert? I suppose that I learned this through a talk given by W. R. Kappel, president of AT&T, at the Technology Conference presented to the FCC on July 18, 1960. In both the talk and the transcript I was made clear that the Bell System is prepared to hear the requests of consumers and development of suitable communications. Yet, in your statement you said "It is also apparent that it will be a long time before such a system could offer sufficient return on investment to be made a part of the corporation in a public stock securities market."

Friends at AT&T and the Bell Laboratories don't believe that is so; they believe the satellite communication has a useful and profitable future. Otherwise, they wouldn't have constructed the Telsa ground terminal on Central Hill at their own expense. And right now some 60 Bell Laboratories engineers, scientists and technicians are working on satellite communication and the number is increasing.

Except for speaking expenses in connection with Project Echo, this work is being paid for by AT&T.

J. B. FERRY
Director of Research
Communications Program
Bell Telephone Laboratories, Inc.
Murray Hill, N. J.

(Although the Bell System is one of several companies that is investing in research in development and studies of commercial communications satellite systems, and Dr. Parzen was one of the earliest pioneers in this field, the fact remains that no company can afford to implement such a system until it can complete successfully with other available terrestrial communications facilities.)

[illegible]

Attention: Freel welcomes the opinions of its readers on the issues raised in the magazine's editorial columns. Address letters to the Editor, *Attention: Freel*, 130 W. 42nd St., New York 36, N. Y. Try to keep letters under 300 words and give a genuine identification. We will use prices anonymous letters, but names of writers will be withheld on request.

Aerial Cameras

In related to Mr. Nishi's comments (AWJ-EC, 15, p. 198), he is apparently unaware of the preeminent characteristics of either the Fairchild KA-65 or the Chengdu Anka-100. The KA-65, part of all three is the statement "The KA-65, by its name, a standard model, produces a photograph which is very similar to the one you have seen." The KA-100, however, is a two-man aircraft, the KA-100 is a standard camera of which more than 150 have been produced to date as according with specifications MIL-C-21781 and used by the U.S. Navy as AN-100P and F-100P (initial) and by the U.S. Army as AN-100A (initial) and UN-101, UN-102-A

USD1 surveillance device. Secondly, the numerous shorter spans of the KA2 are given by EU MSA 5-63 as 1/1800 sec with the 6 m, 1/640 lines (although a few have been modified to 1/1600 sec.) and 1/4000 sec with the 12 m, 1/640 lines. The one profile longer for the KA33 are the 3 m, 1/432 and 6 m, 1/216 and the numerous shorter spans are 1/1800 sec and 1/4000 sec, respectively, as specified by TM 11-6730-208-12 (after stated to have a TM published for a reason that is "by no means a standard model" -a? (2).

Next, the statement is made that image motion compensation is of little value in high altitude photography. This statement is based on the fact that the maximum image length on the W in $c \circ$ is about 1% of the K_A , so its reproduction h on film length on the W is 1/40 its extent at the W and $1/20$ its extent at the W in $c \circ$. This means that the apparent size is at 9 days 30 mm depression and the lowest at 50 day 30 mm. In practice, it is generally considered that in the case of high altitude photography, the effect of the critical aspect of horizontal objects (and/or small distant objects) on their aspect of depression at 20 day, as well, little or no deformation is caused. Thus, the apparent size of the objects is about 1% between 20 day and 50 day 30 mm. If the apparent image h for a depression angle at 34 day $c \circ$ is used, then image ratio will be 1/20 of the apparent value at the 18 day depression angle. The image ratio is also 1/20, if the image ratio is used at the 18 day depression angle, at 30 day 30 mm. The relative motion blur (or image ratio) is thus at most, 18% at the extension and approximately 1/20 at the 34 day depression angle.

Thus, all course, means that if two cars can have the same *average* speeds, but only has EME and the other doesn't, under these circumstances, the relative motion

While it is enough the DAC engine has twice the motion stopping ability as effective that let speed. The K430 can use its DAC up to 5 cycles per second, whereas the A20 DAC engine for the K430 (an analog) we are qualified experts, having built them) is limited to 2 cps. Quite simply, at low altitudes and high ground speeds, you need more than two pictures per second to send data in the coverage. Therefore you must fly slower or accept gaps in the coverage.

Finally, note the disparity in speed of the lenses—0 in F:6.3 vs. 5 in F:4.5 and 12 in F:4.0 vs. 6 in F:2.8. Since the light-gathering power of the lens is proportional to the square of the *F* number, the KX 56 can run twice as fast a shutter speed as the KX.2, at just another way, can run at three times speed at light levels half as high.

Perhaps there are also reasons the Air Force is considering 70 mm camera and H-1 cameras (among others the KA-50) both to retrofit the NF-111 and as the primary camera in the aircraft planned to upgrade the NF-101. Indeed, if Fairchild Camera and Instrument Corp. has any business faith in their KA-2, why did they offer their KA-15 70 mm camera to the Soviet Tu-16 for Command reconnaissance test program for the next NF aircraft at Shaw AFB?

James R. Davis
Manager, Service Engineering
Chicago Aerial Industries, Inc.
Melrose Park, Ill.

Phoenix Pilot

It was a great surprise to us to find in the July 15 issue of *American Water*, p. 122, under the photo of our Florida glider, that Eric Cuthbert (name comes from Ireland).

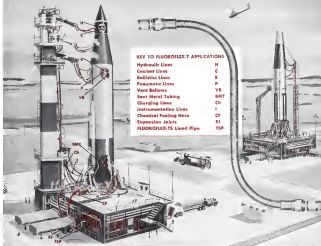
We assume that this is a mistake, but to make sure we consider it necessary to inform you of the detailed situation so that you are able to publish a correction in your journal as soon as possible.

The 22 symbols, high performance Fluoro glides were designed by Dipl Ing. Noriko and Dr. Eppeler of the Technical College at Stuttgart. Both were later awarded our first Production of this model is now being undertaken by Apparition, Nilsen GmbH, and with the support of Kuhn-Entwicklungen K.G. an improved version with a T100 has been built.

Dipl Ing. Eppeler-Noriko is a Group.

He joined Boffon-Entwicklungen K.G. as chief designer some time ago. The only exhibition he had with Poland was when he won the world championship in the open class there in 1998.

Roman-Englishman EG
 Orthodox or. Muslim
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Hydraulic Lines	H
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Source: U.S. Census Bureau, *U.S. Life Tables, 1999*, Table 1A, 1999.

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**Why this
ESNA floating anchor cap seal nut
will soon be probing
outer space**

This Type A4040 floating anchor, base seal, capped nut has been selected to go along on the first manned space flights aboard the National Aeronautics & Space Administration's Astronaut capsule. We can't illustrate this special application as yet, but we can tell you about the unusual performance characteristics of this new design.

Type A4040 is a self-locking anchor nut with a special "O"-ring in the base that provides an hermetic seal to prevent loss of air pressure through seepage along the bolt threads. The stop nut held captive inside the dome provides .020 inch minimum radial floating action to allow quick bolt installation in spite of slight misalignment of bolt holes. It is 100% seal tested before shipment. The seal is effective whether the bolt is installed or not, and is not destroyed by repeated bolt installations. It will withstand vibration and temperature variations from -70°F . to 400°F .

The A4040 is a typical example of ESNA's willingness to work on the special fastener problems faced by engineers who are designing for the space age.

Let us send you complete details on the wide variety of cap seal nuts specifically designed for internal fuel tank fastenings to prevent seepage of volatile fuels: two lug (A2502) and its miniaturized equivalent A2506; one lug (A2507) and straight gang channel strips (G2500). Consider too, the access door design opportunities provided by a football-shaped ring of cap seal nuts such as the one illustrated above and which is performing outstandingly in the integral fuel tanks of one of the nation's newest jet liners.

Write . . . Dept. S54-925, Elastic Stop Nut Corporation, 2330 Vauxhall Road, Union, New Jersey.



Type A4040



A2502



A2507

Miniature A2506



G2500



**ELASTIC STOP NUT
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